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ORIGINAL MEMOIRS

THE TREATMENT OF TUBERCULOUS CERVICAL LYMPHADENITIS.*

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THE following remarks are based on a fairly comprehensive study of the literature of the last ten years and upon an analysis of the cases of tuberculous lymphadenitis admitted for operation to the service of Dr. C. H. Frazier in the University Hospital during the past twelve years (to January 1, 1913). They were operated upon mostly by Dr. Frazier and by those of us who have been associated with him during that time. Seventy of the cases were admitted during my own connection with the service.

Briefly, there were 103 cases studied; 50 in the male sex; fifty-three in the female. The cervical nodes were affected in 96, the inguinal in 3, the axillary in 3, and both the cervical and axillary in one. The ages ranged from 11 months to 40 years and may be subdivided as follows:

Cervical Cases (in infants under two years).—There were only two (2 per cent.) in this group; one, a boy of eleven months had developed a submaxillary mass five months before admission which had broken down and was discharging caseous material through a sinus. There was no evidence of a portal of entry but an older brother had experienced the same affection. The mass was dissected out. The child recovered but returned to the hospital 17 months later with a tuberculous dactylitis which was curetted. In September, 1908, three years after the original operation, 19 months after the second, there was no evidence of either trouble. He has since been lost sight of. The other patient, a girl of sixteen months, developed acutely, seven months previously, a high anterior cervical swelling, which presented on admission a fluctuating mass. It was incised and partly dissected out. The tonsil seemed to be the portal of entry and one uncle had died of tuberculosis. Two years and nine months later the child was reported as being free from recurrence.

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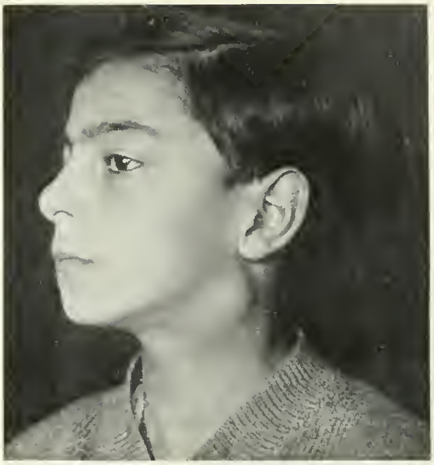
* From the Service of Dr. C. H. Frazier in the University Hospital, Philadelphia. Read before the Academy of Surgery of Philadelphia, April 7, 1913.

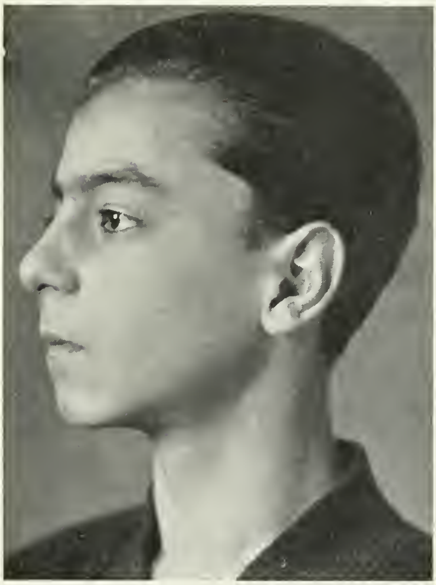
Approximately 3 per cent. of the 465 cases recently reported by Dowd were below the age of two years and he believes that this group shows less power of resisting tuberculosis than the other groups. One of his cases also developed a spina ventosa. Two of the fifteen died within six months of their operations but the ultimate results of the others were quite good. Some interesting facts are brought out by Harbitz (*Jour. Infect. Diseases,* 1905, vol. ii, p. 143) in regard to postnatal tuberculosis and he quotes cases where death has occurred as early as the eighth week. The source of infection in our cases could not be determined but must have been from milk or the dust of the floor. La Fetra (*Archives of Pediatrics,* 1907, xxiv, p. 418) has reported a case of tuberculous lymphadenitis in an infant of four months in which there was no evidence whatever pointing to the source of the tuberculous infection except the contraction of several colds and the fact that the father had a cold in the head at the time of the infant's birth. The child was fed on milk from a model farm and there was no sign of family tuberculosis. It was believed probable that the first cold was taken from the father or from the street dust and that later, perhaps through the inflamed tonsil or nasopharynx, the tubercle bacilli penetrated to the lymph streams leading to the deep cervical nodes.

FIG. 1.



Tuberculous cervical adenitis. Tonsils removed nine months previous, mass persisting. Location the usual one seen in children.

FIG. 2.



Ideal result fourteen months after operation. Scar scarcely visible. Transverse incision.

Cases in Children (two to seventeen years, inclusive).—In our series there were 49 cases in this group, 50 per cent. of the entire number. This corresponds to the figures of Fischer (46 per cent.) and is far below that of Dowd who observed that 80 per cent. of his cases were in this age group. All of the patients recovered from the operation and of 37 traced, the following was obtained: In 32 there was no recurrence; 2 had died; and 3 had suffered a recurrence.

One patient, a male, age three, was admitted August 19, 1901. The history is meagre, there was a tuberculous family history and several glands were removed from the neck, the wound being drained. A note on the history states that the child died in December, four months later, but I have not been able to verify it.

The second patient was a girl, seventeen years old, who for 18 months before admission had been developing a mass on the right side of the neck. When examined, April 7, 1904, she presented a mass extending from the mastoid to the clavicle. Many of the nodes were discrete and hard. The right lung was also involved. The neck was dissected out and on May 19, 1904, she returned and was operated on for a mass in the axilla. Death occurred November 28, 1904, from pulmonary tuberculosis.

Of the three recurrences, two were in young colored girls, six and eleven respectively, who had extensive bilateral masses in the neck. Both sides were dissected out but in both cases recurrence occurred and one of them is now in the Philadelphia Hospital with bone involvement; the other is living, six years after operation and with recurrence but I cannot ascertain the exact whereabouts. The third case was operated on in October, 1912, and has a slight recurrence. He has had careful X-ray treatment since operation by Dr. Pancoast.

NOTE.—Since this paper was read this boy was operated upon on April 28, 1913, by Dr. Frazier and a few nodes and some tuberculous granulation tissue were dissected out.

Thirty of the thirty-two cases free from recurrence have been heard from during a period of 1 to 11 years since operation, nineteen up to 5 years and eleven over five years; three cases operated on within a year are free from recurrence.

Cases in Adults (over 17 years of age).—There were forty-six in this group. These patients also recovered without exception from the operation and of 28 traced, 18 were free from recurrence, 4 had died, and 6 suffered from a recurrence.

The cases free from recurrence, with two recent exceptions, were heard from at periods varying from 1 to 12 years since operation. In seven cases over 5 years have elapsed.

Of the deaths, one, a man of thirty-three, was operated on in October, 1903, four years from the beginning of the affection during which time he had 3 operations elsewhere. There was spinal caries in addition; he died eighteen months after our operation. The second, a woman of twenty-six, was operated on in April, 1903. She had extensive involvement of both sides and they were dissected out in two sittings. She died two years later from pulmonary tuberculosis. The third death occurred in a man of twenty who was admitted during February, 1910, with a mass reaching from the ear to the clavicle. He died of pulmonary tuberculosis in March, 1912, but there was no recurrence in the neck and the letter states that the scar was scarcely visible. The fourth death, a man of twenty-six, was admitted in March, 1911, with a mass extending from the ear to the clavicle, and a mass in the groin and a pulmonary lesion. The cervical mass was of three years duration. He died six months after operation.

As to the five recurrences, Case I, male, age twenty-four, has a note on his history that he was re-operated on in 1911, eleven years after the original operation. There are no other data. Case II, female, age twenty-one, operated on in June, 1909, for a large mass of two years' duration, states that she has recurrence but has had no second operation. Case III, female, age twenty-one, with a small submaxillary mass in both sides operated on in May, 1910, in a curt note simply states that she has had a recurrence. Case IV, male, age forty, also had a small submaxillary mass, operated on in April, 1911, probably has a recurrence but he is quite illiterate. Case V, male, age twenty-three, operated on in June, 1911, for a large mass in the neck, states that he has a soft swelling under the scar. Case VI, female, age 21, was operated on in May, 1904. She states that two years later a recurrence occurred which was cured after three years of X-ray treatment.

Dowd (*Surg., Gyn. and Obs.,* 1912, vol. xiv, p. 353) states that adults present a different type of lymphatic tuberculosis. "The infected lymph nodes, instead of caseating in the upper part of the neck before the lower part is involved, are apt to extend throughout the entire side of the neck so that the lower nodes become enlarged almost as much as the upper ones." He had one death in the series, apparently from pulmonary embolus.

In our cases the results may be summarized as follows:

	Cases	Traced	Cured	Recurred	Death (remote)
Infants ...	2	2	2	0	0
Children ..	49	37	32	3	2
Adults	46	28	18	6	4
Total ...	97	67	52	9	6

In four of the cured cases we performed more than one operation; in that sense they recurred but such recurrences were prompt. In at least one-half of the recurrent cases it seems probable that further operation would bring about a cure.

Inguinal Adenitis.—We observed three cases, all in males, nineteen, twenty-five and thirty-seven years old respectively. They all recovered from operation but their subsequent history cannot be learned. In one case the affection followed a "bubo," in another a scratch on the thigh had existed for three weeks previously, and in the third no cause could be ascertained.

Axillary Adenitis.—There were four cases in this series, one of which, a boy of eight, had a coincident cervical adenitis. One patient, a male, age thirty-three, ascribed the swelling to a fall on the shoulder; another, a female, age eleven, stated that it developed two months after recovery from typhoid fever; and the fourth, a female, age thirty-two, had a thecitis 19 months previously, although the axillary swelling did not appear for 18 months thereafter. All recovered from operation, the first two cannot be traced, the third was free from recurrence one year later and the fourth died of pulmonary tuberculosis five years after operation. From the subsequent history we learned that she had had a spinal caries in the interval, apparently cured by the wearing of a brace.

Etiology.—It is generally admitted that cervical tuberculous lymphadenitis represents the local deposit and proliferation of the tubercle bacillus from some lymph vessel draining a particular portal of entry. The faucial tonsils are generally considered the most frequent of these portals, followed in order of importance by the pharyngeal tonsils or adenoids, middle ear disease, carious teeth, lesions of the buccal and nasal mucous membranes and various miscellaneous causes—cracks and fissures and skin diseases, etc. The consumption of tuberculous butter or milk, the childish habit of sucking the fingers, pencils and other objects picked up from the floor, the influence of flies that deposit the bacilli on food, etc., especially in a household where some other member of the family has or has had tuberculosis or where some tuberculous person previously has lived in the house, all favor the deposition of the organisms at the portal of entry. It would be of no practical importance to enter into the controversy as to the exact percentage of tuberculous tonsils that are present in tuberculous adenitis nor to discuss whether the tubercle bacillus can pass through the tonsil into the lymph stream leaving no trace of its passage. Harbitz has isolated the tubercle bacillus from cervical lymph nodes showing no visible macroscopic or microscopic evidence of tubercle, latent infection, he terms it. That such can occur seems undoubtedly to be true and when we considered the rather widespread downward sweep of tuberculous cervical lymphadenitis in the adult and have knowledge of the termination of the lymph vessels in the blood stream we can readily perceive the danger to the individual of a tuberculously infected portal of entry or a progressive involvement of the nodes. They do not act as filters, merely as a very important part of the defensive mechanism.

The constant presence of enlarged lymph nodes in the majority of children is not so well known that the following figures from the older literature need not be repeated. Thus, Colland (*Zeitschr. f. klin. Med.,* 1893, xxiii, p. 50, and *Munch. Med. Woch.,* 1904, li, 87), in an examination of 2506 persons between the ages of 7 and 24 years, found that 94 per cent. of those between 7 and 12 years had enlarged cervical nodes. Laser (*Deutsche. Med. Woch.,* 1896, xxii, p. 500) examined 1216 school children, 1079 (89 per cent.) of whom had enlarged cervical nodes. He came to the conclusion that in 32.4–58.9 per cent. of the cases tuberculous nodes were present. In the report of the Division of Child Hygiene of the Boston Board of Health for 1911–1912 the physical examination of 118,781 school children revealed 13,711 cases of enlarged cervical glands. From these statistics, and there are numerous others, it may be concluded that swelling of the cervical nodes is very frequent and in a large number of cases that this swelling is of tuberculous origin. Now, no one supposes that all of these children develop a persistent clinical mass, probably not 2 per cent. of the Boston cases came to operation. The vast majority subside as they clear themselves of the infection. Herein lies the success of the tuberculin, hygiene and perhaps of the X-ray treatment.

Another point of practical importance has been brought out by Wright (*Brit. Med. and Surg. Jour.,* 1913, clxviii, p. 232). He states that the tonsils may become enlarged without infection or disease whenever (*a*) the first group of temporary molars at two years of age are in process of eruption; (*b*) at six years, when the first permanent molars, and at 12 years, when the second molars are active in eruption. The teeth may be diseased at these periods and be a source of infection, and enlargement of the tonsils and glands.

Pathology.—From the lymph vessel the organisms pass to a node, are arrested or destroyed there or else pass through to the next one and so on. If the resistance of the first node or nodes is sufficient there is interposed an effectual barrier, even if the node is destroyed. This is especially the case in the child where the lymphatic tissue has great activity and explains the tendency of this disease to remain localized in children, to the upper part of the neck in the region of the first group of nodes invaded by the infecting agent. Dowd (*Surg., Gynec. and Obst.,* 1912, xiv, p. 353) remarks that 80 per cent. of his cases occurred between the ages of 2 and 17 and almost constantly this group is regular in its clinical picture; viz.: a localized mass below the parotid and either in front or behind the sternomastoid muscle. It is well that this is so when we turn our attention to the lymph paths.

Roughly, the tonsils and pharyngeal region empty into nodes that lie a little below and behind the angle of the jaw, and immediately in front of or under the anterior edge of the middle of the sternomastoid muscle. The lymphatics in front of, and above, the auditory canal lead to the preauricular nodes, and they become enlarged from any infection of the forehead, an eczema or intertrigo in the crease between the scalp and ear, a furunculosis of the anterior wall of the auditory canal, etc.; usually the infection is pyogenic, occasionally tuberculous. The central portion of the face, roughly from above the outer corner of the mouth, and from below the outer corner of the eye, drains into nodes situated about the facial artery and vein in front of the angle of the jaw; fissures and sores about the nostrils, and about the corner of the mouth and eye, and irritations within the nose may cause their enlargement. The lymphatic vessels from the lower lip and chin drain into the submaxillary or submental nodes. The scalp drains into a group beneath the occiput, and the middle ear, mastoid, and overlying tissues drain into a group under the mastoid. Infections of the gums or bone about the roots of the teeth pass from the upper jaw to the nodes at the angle of the lower jaw and from the lower jaw directly into the submaxillary nodes.

These nodes may be classed anatomically as a superficial parotid and a superficial submaxillary, the latter being so intimately associated with the deep submaxillary under the fascia as to be indistinguishable clinically; a superficial cervical situated along the posterior edge of the sternomastoid muscle and a deep cervical along the course of the vessels. More extensive classification will be found in the text-books on anatomy. The terminal collecting trunk of the cervical lymphatics on the right side usually empties directly into the venous junction, occasionally as a common trunk with the subclavian lymph vessels and only rarely these two and the bronchomediastinal trunk are in junction. On the left side the jugular trunk usually empties into the terminal bend of the thoracic duct and rarely is associated with the other trunks.

Treatment.—I do not wish to be understood in this paper as making any plea for operative treatment as opposed to the use of hygiene, tuberculin or the X-ray, but I do hope to be able to present to you certain arguments showing the need of radical surgery at the right time and in the right manner. Following the dictum of the tuberculin and X-ray enthusiasts, many writers decry the use of surgery until softening has occurred at which time incision and drainage is practised or else the cavity is aspirated and filled with iodoform, formalin and glycerin. The arguments against operative treatment may be said to be grouped into two classes: First, by those who believe that recurrence, disfiguring scars, paralysis following nerve injuries, or contractures from muscle injury are of frequent occurrence; and second, by those who believe in the tolerance which the individual, especially the child, may have to certain forms of tuberculosis and the stimulation of an immunity by the tuberculous focus especially when activated by tuberculin. In addition, series of reports of cases cured or improved by tuberculin or by X-ray are often quite encouraging and the natural dread of submitting children "to the knife" popularizes these methods of treatment.

We can dismiss the mortality of operation in a few words. The extremely low mortality is surprising when the difficult nature of some of the operations is considered. We did not lose any of our patients during a period of twelve years. Judd (ANNALS OF SURGERY, 1910, vol. lii, p. 758) states that 649 patients have been operated on in the Mayo clinic without any operative mortality although one patient died a few weeks after operation of general tuberculosis and a second died in about three months from diffuse sepsis. The older statistics of Jordan, Wohlgemuth and Blos give similar results. Dowd reports two deaths in 465 cases, one of which, an adult, was found dead in bed, probably from pulmonary embolus. Of the Mayo cases, 19 subsequently died of pulmonary tuberculosis, nine of other tuberculous lesions. Of our series, three subsequently died of pulmonary tuberculosis, one of spinal tuberculosis, and in two the cause is unknown. In the older literature Jordan among others speaks of the favorable influence of operation upon the pulmonary lesion. In one of our cases operated on eight years ago there were signs of involvement of the apices. He is now perfectly well.

The objection of the scar is well founded. No one wants a scar in any visible portion of the body and the neck scar if conspicuous marks the patient as tuberculous. But much of the talk about disfiguring scars is ridiculous. Of 53 of our patients seven complain of unsightly scars. Three of these were advanced, diffused lesions, requiring drainage for the spaces left after the dissection. In one a transverse incision with drainage lasting for some time, while it gave a bad scar, and the fifth was an easy case which healed up by first intention; some error in technic must have been the cause of the scar in this case. With this exception every easy case has a small neat scar and in twelve cases the patients declare it can hardly be seen. We are now particularly careful to sew the platysma and fascia with plain catgut and use fine worm gut, horse hair, or the subcuticular stitch for the skin. If drainage is needed we introduce a small piece of rubber tissue through a minute puncture below the scar. In extensive dissections requiring the vertical posterior incision, we drain either through a stab wound or at the lower angle of the long incision. The rubber drainage in most cases is removed in 24 to 48 hours and an attempt made to get a primary union; if necessary the pocket may be carefully and aseptically re-opened every other day with a grooved director and the serum and lymph evacuated. Care must be taken that the throat wounds are kept clean if the tonsils and adenoids are cleaned out at the same time as the adenectomy, otherwise infection of the wound is bound to occur. Care must also be taken of the pocket under the parotid if that organ is cut, usually by sewing the gland down and by the administration of urotropin. In a few cases a severe lymphœdema has occurred, most annoying at the time and usually provocative of delay in healing. Of course, in the advanced cases with a radical dissection, some scarring is to be expected; one might just as well argue against the performance of operation for appendicitis because of the occurrence of incisional hernia, which may easily result in neglected cases when extensive drainage has been used.

As to the second point, the nerves that may be injured during the operation are the pneumogastric, facial, hypoglossal, spinal accessory, and certain of the superficial branches of the cervical plexus, especially the fifth cervical. The vagus is so deeply placed and so easily isolated that its injury is almost inexcusable. The facial trunk is also deep and even in the parotid involvement should not be touched; certain cervical fibres of the facial nerve which supply the depressor muscles of the lip are often cut, torn or crushed with a resulting slight, but deforming droop of the lower lip on that side. The nerve clings tightly to the under surface of the superficial layer of the deep fascia and if the incision is placed one-half inch below the jaw and deepened so as to carry the fascia up with the skin and muscle the nerve can almost invariably be avoided. In one of our cases I cut the hypoglossal nerve and in spite of suture a hemiatrophy of the tongue resulted. The case was advanced and very difficult but there was hardly any excuse if I had properly located the nerve. The spinal accessory is the nerve most frequently divided with permanent asymmetry of the shoulders and a scoliosis in about one-third of the cases. For this reason it should be carefully searched for and preserved. When the anterior deep cervical nodes enlarge they are apt to dip in between the internal jugular vein and the nerve in the inch or so of its course from beneath the posterior belly of the digastric to its point of entrance to the sternomastoid. In old cases the capsule of the nodes is firmly adherent, but the nerve can generally be defined if a sufficient exposure be made by firm retraction of the muscle. In the posterior triangle the nerve crosses the space in a species of groove between the nodes and perhaps runs its greatest risk of being cut where it emerges from the sternomastoid at or slightly above the middle border of this muscle. Jacobson (*Ohio State Med. Jour.,* 1908, vol. iv, p. 9) offers an additional reason why the nerve should be preserved. The muscles of the chest are in a measure auxiliary muscles and are needed especially in pulmonary tuberculosis, and he has observed that patients with slight lung involvement do badly when the spinal accessory nerve is divided. While division of the sensory branches of the cervical plexus seems a matter of small moment, Murphy (*Prac. Med. Series,* 1906, vol. ii, p. 262) calls attention to injury of the fifth cervical nerve which produces paralysis of the rhomboid muscles, permitting the scapula to project backward. He believes it is more serious than division of the spinal accessory. In our records of 56 patients the spinal accessory was surely cut once and possibly in a second case. One patient only complains of a droop at the angle of the mouth, although I know of one other case where I cut the cervicofacial nerve but the deformity disappeared in six months. In one case, as mentioned, the hypoglossal was cut. There is no necessity for the division, removal or injury of any muscular structure unless it is hopelessly involved by the morbid process. We have entirely given up the division of the sternomastoid muscle to get more room. It seems to us, therefore, that this objection is not well founded unless one considers bad operating as a contra-indication to operation.

As to the third point, viz., recurrences, I have given our own statistics with 85 per cent. of cures in the cases traced that are living and this figure would be increased by re-operating on three or four of the nine recurrences. Dowd, in his address before the Congress of Surgeons meeting in Philadelphia in 1911, stated that from his experience " we may fairly expect freedom from recurrences in 75 per cent. and permanent recovery in 90 per cent. of the cases." In Judd's collection of 649 cases there were 8.6 per cent. of recurrences in the region of the former operation. I am almost tempted to say that with proper technic, recurrence is impossible,—we have simply failed to entirely remove the infected nodes. Stone (*Boston Med. and Surg. Jour.*, 1912, vol. clxvii, p. 537) believes that the recurrence after radical excision is due to the failure to recognize and remove the primary foci of infection or the vulnerable points of entrance.

The Indications for Operation.—It is not easy to indicate clearly those cases which require operation and those which should be treated by other means. Judd outlines the following method of treatment:

Clear the throat of the adenoid tissue and tonsils, attend to the teeth and nose, administer tonics, especially the syrup of ferrous iodide, and advise out-door living. He believes that many of the cases in the hyperplastic stage or as Bennett would say, during the period of bacillary invasion, are cured by these measures. After caseation occurs, Judd removes the infected nodes and drains the wound. If in spite of treatment, the nodes continue to enlarge and other nodes become involved, he performs a complete excision; in the presence of a discharging sinus he curettes the softened mass, swabs the wound with equal parts of tincture of iodine and carbolic acid and when the sinus heals a radical operation is done if necessary. Stone is much more radical in his advice, he asks, " What can be gained by delay? The possibility of arrest, or if a mistake in diagnosis has been made, of cure; the probability of caseation of the entire gland to spread into the surmounting tissue, with the necessity of surgical interference under most unsatisfactory conditions, or the tedious natural discharge through a chronic sinus."

He does not minimize the value of hygienic treatment or the value of resistance, but emphasizes the fact that encapsulation of a tuberculous foci does not cure the disease which remains as a smouldering fire ready to flare up if the proper conditions of trauma, fresh infection, or decreased resistance arise. I will summarize our own position in a moment.

Tuberculin Therapy.—There seems to be no unanimity of opinion among the writers on the treatment of tuberculous lymphadenitis as to the value of tuberculin in treatment. Various writers either support its use with intense enthusiasm or else state that the good results obtained are due to the improved hygiene, fresh air and regulated diet that are instituted coincident with tuberculin treatment.

Allen (*Vaccine Therapy, Its Theory and Practice,* London, 1910) states that "out of eight cases there is an expectation of marked improvement in five, slight improvement in two, and complete failure in one or two." Carmalt Jones (*British Medical Journal,* 1909, vol. ii, p. 531) states that out of 79 cases treated by inoculation "27 were cured, 21 made much better, 18 made better, 8 unaltered, and 4 made worse." Raw (*Lancet,* 1910, vol. i, p. 844) considers that "glands in the neck are the most favorable lesion for treatment with human tuberculin." He treated 62 cases with "very astonishing and excellent results," but the extravagance of this and other statements in his article vitiate the soundness of his observations. Hawes (*Boston Med. and Surg. Journal,* 1912, vol. clxvi, p. 80) after stating that the physician should not depend upon surgery alone, hygiene alone, nor tuberculin alone, believes that of 56 patients treated by improved hygiene, fresh air, out-door sleeping, improved diet, etc., and tuberculin, in 27 the disease was apparently cured or arrested, while in 16 others the condition of the patient was improved. I might continue to quote from various other authors more or less indefinitely but it seems to me that while I would not agree with Hawes in his belief that the so-called radical operation is comparatively rarely indicated, yet I do agree with him "that the broad-minded physician will not claim that surgery alone, hygiene alone or tuberculin alone will cure tuberculous adenitis, but he will use each and all of these three methods of treatment according to the needs of the individual patient."

The action of tuberculin is simply the production of a degree of focal reaction followed by an adequate but not excessive auto-inoculation. In the hands of those skilled in such therapy it may be used as a valuable adjunct to surgical treatment, in unskilled hands it may act as a dangerous boomerang.

Recently, Waugh (*Quarterly Jour. Med.*, 1911, iv, p. 521) in a critical review of the use of tuberculin in so-called tuberculous glands concludes "that any estimate of the value of injections of tuberculin in the treatment of enlarged glands must be invalidated by the fact that *no proof* that the glands were tuberculous can be offered until the glands have been subjected to operation." He reports that of 130 cases of presumably tuberculous glands where the tonsils were dissected out, 16 (12.3 per cent.) came to radical operation and 13 (10 per cent.) developed local abscess formation. Of 51 cases where tonsillectomy was followed by tuberculin treatment, 10 (19.6 per cent.) came to operation and 9 (15 per cent.) developed abscess; (in three cases where no primary focus existed, and treated with tuberculin, all recovered). Bennett, although he advocates its use, does not believe that tuberculin does much good and thinks that many cases of recovery are due to the improvement of hygiene and the food supply. Sutcliffe states that the cases in which apparent benefit has resulted are precisely those cases that would have recovered equally as well without it, and that the observation of children treated with and without tuberculin revealed no perceptible difference in the rate of absorption of the diseased nodes.

The X-rays.—The action of the X-ray in these cases is still uncertain because of the unfortunate habit which some radiographers have of exaggerating the "magical" properties of the rays. A number of writers have advocated this form of treatment to the exclusion of everything else, during the last few years and they habitually attack operative procedures as dangerous, disfiguring or subject to failure. But as has been said, bad surgery is not a contra-indication to operation and if a surgeon does not know how to operate for tuberculous glands in the neck he had better turn to other forms of treatment.

Pancoast (*Penna. Medical Journal,* February, 1909) in a letter to Dr. Frazier believes that while the X-ray deserves recognition as a valuable and efficient adjunct to surgery in the treatment of tuberculous adenitis, certain fundamental facts concerning its therapeutic action should be borne in mind. He believes that: (1) The X-rays have no direct bactericidal action upon the tubercle bacilli; (2) their probable action is an indirect one, a stimulating effect upon the surrounding healthy tissue cells and an increase in their nutrition; (3) the rays hasten destruction of cells of lowered vitality and the suppurative process in enlarged glands in which caseation has begun may be hastened; (4) the X-ray is a valuable adjunct to surgery in simplifying operation, preventing recurrences, promoting healing in suppurative and serious cases and greatly improving the cosmetic result.

> In the application of the X-ray he arranges the cases in three distinct groups: (1) Cases in which the enlargement has not reached the operative stage. In a large percentage of such cases it is possible to check the progress of the disease by systematic and careful X-ray treatment combined with the essential constitutional measures. But it is not always possible to promote a complete absorption in some of the larger glands even though the disease process is checked because of the inability to remove the excessive degree of hyperplasia. (2) As a post-operative treatment in cases in which the glands have not begun to undergo caseation. Where operation has been limited to the removal of the large nodes, post-operative X-ray treatment may check the disease in the smaller ones. (3) As a post-operative treatment in cases in which caseation or suppuration has begun, especially in cases where sinuses have formed.

The above is an abstract and represents our own opinion and practice in advising the use of the X-ray. I would call attention, however, to the statement by Dr. Pancoast in which he refers to large nodes, etc., which have not begun to undergo caseation. This is a common error noticed in all the articles written by tuberculin and X-ray advocates and by those without operative experience. The simple hyperplastic node is a small one and when a tuberculous node becomes large and visible it will always be found to be caseous. In fact, I do not remember ever having operated upon a case of tuberculous lymphadenitis in which at least one of the nodes was not caseous.

The Manner of Interference.—I will not burden you with a detailed description of the technic of operation; we are mostly surgeons and quite familiar with the details. The description by Judd of the operation done with the long posterior incision is most thorough and should be consulted by those unfamiliar with his paper. The papers by Dowd (ANNALS OF SURGERY, 1908, xlviii, 169) describe the steps of the operation through the transverse incision. As to whether the dissection of the glands should be done by knife, dissector, scissors, or gauze will depend on the personal experience of the operator. The Mayo scissors are certainly safest and if used with skill almost as rapid in execution as is the knife. Care should be taken to avoid "spilling" the caseous contents of the nodes and if such occurs the wound should be mopped out with Harrington's solution or tincture of iodine. Perfect hæmostasis must be secured at the close of operation, blood clots favoring wound infection. Drainage and wound closure have already been discussed.

There are two complications that deserve mention. Soft, bulging caseous masses are perhaps best treated by aspiration and the injection of iodoform emulsion and formalin, although our experience with this method has not been very satisfactory. We prefer a small incision, curettage of the cavity with gauze, thorough disinfection with Harrington's solution and drainage with rubber tissue; care should be taken that the entire cavity has been opened and that we are not dealing with a so-called shirt stud collection with an outer pocket on the deep fascia, and an inner pocket beneath. If such cavities are encountered at operation every bit of the wall must be excised. If the symptoms indicate that mixed infection has occurred, hot fomentations may make incision more easy and safe to execute, but delay is not justifiable if the infection is extending down under the cervical fascia or symptoms of general septic infection are threatening.

Where sinuses, indurated areas, and old thick scars are encountered there is no better treatment than curettage of the sinus and exposure of the neck to the X-ray. Tuberculin is of notable value in such cases and its use is based on sound reasoning.

The after treatment of these patients is of particular importance. While an operation may remove at one stroke all the infected tissue, yet the patient's resistance to tubercle infection is low and his surroundings still with him. The hygiene is of particular importance but need not be discussed here.

In conclusion I might summarize our own views somewhat as follows: After a careful history has been obtained and an examination made the portal of entry can usually be surmised and if necessary the tonsil, adenoid or carious tooth should be removed, or any ulcer, scab, pediculosis, otitis, etc., attended to. In those cases seen early with only a small area involved and where the child is in good general health, an operation should be advised. If the social position permits, this dissection should be confined to the macroscopic group with a minimum scar and the child sent to the seashore and kept from school for one year; the general and hygienic details of treatment being carried out with scrupulous care. In the case of the poor child or where such cannot be carried out, I think the entire submaxillary and cervical chains above the omohyoid should be excised. The general treatment must then be carried out at home. If the case is seen late with one or both sides choked up, the X-ray is often of advantage in reducing the hyperplasia and a radical dissection can be carried out at an opportune time. If caseous abscesses, sinuses, etc., exist they should be opened up, curetted out and an effort made to thoroughly clean up the tuberculous granulation tissue after which the X-ray is often invaluable in promoting healing. We prefer the transverse incision whenever possible, especially for the submaxillary and upper part of the deep cervical. When the mass has crossed posteriorly beneath the muscle or involved the posterior superficial cervical chain, an oblique incision from the posterior edge of the mastoid along the posterior edge of the muscle to just below its middle and then prolonged transversely to the thyroid muscles will give a large field area. Finally, intratracheal insufflation anæsthesia offers immense advantages in difficult cases, although pharyngeal insufflation anæsthesia suffices for the easy ones. At all times we must keep in mind that we are "not only treating a case of tuberculous glands but are dealing with a human being infected with tuberculosis. The difference between the two points of view is enormous and the success will largely depend upon the one chosen by the physician" (Hawes).

In conclusion I wish to express my indebtedness to Dr. Frazier for permitting me to collect and report his cases as well as for the privilege of using his wards for my own patients and in many instances for operating on his patients.

EXCESSIVE THICKENING OF THIERSCH GRAFTS CAUSED BY A COMPONENT OF SCARLET RED (AMIDOAZOTOLUOL).[1]

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INTRODUCTION.

THERE has been some skepticism expressed at one time or another in regard to the power of epithelial stimulation claimed for certain of the organic coloring matters (scarlet red; soudan III; azodolen; pellidol, etc.), when applied locally to granulating wounds.

To my mind this matter has been settled beyond a doubt, as, during the last four years a number of enthusiastic articles have been published by well known investigators on the satisfactory use of these substances. These papers almost uniformly report splendid clinical results in hastening the healing of sluggish granulating wounds of varying etiology, and in every situation.

As is usual when a promising new therapeutic agent of this type is brought to the attention of the medical profession, it has been used by many who are not familiar with the prin-

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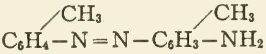
[1] Amidoazotoluol is an amidoazo compound employed as an intermediate product, which, when combined with Beta naphthol, forms the scarlet red originally used, experimentally, by Fischer,[a] for the production of atypical epithelial proliferations; and first used, clinically, by Schmieden.[b] Amidoazotoluol was first used clinically by Hayward.[c] It has the formula—



$$\overset{\diagup CH_3}{C_6H_4} - N = N - \overset{\diagup CH_3}{C_6H_3} - NH_2$$

[a] Münch. med. Wochenschr. Nr. 42, October 16, 1906, S. 2041.

[b] Zentralbl. f. Chir., Nr. 6, February 8, 1908, S. 153.

[c] Münch. med. Wochenschr. Nr. 36, September 7, 1909, S. 1836, and Deutsche Zeitschr. f. Chir. Bd. 112, 1911, S. 467.

ciples of wound healing, and who have little knowledge of surgical dressings. If unfavorable results have been obtained by such individuals, I do not believe it is entirely due to the dyestuff.

I have found that these substances will not heal every wound, but, in the majority of instances, when applied with the proper technic, they will cause epithelial stimulation in the edges of the most sluggish wounds, and give a rapid, stable healing.[2]

The use of these coloring matters has also been objected to, by some who admit their power of epithelial stimulation, on the ground that there might be the possibility of producing epithelial overgrowths having malignant characteristics. It is a well known fact that malignant degeneration may occur in any chronic ulcer, even though only the blandest dressings be used. The consensus of opinion, deduced from experimental and clinical work, is that there is no more danger of producing malignant growths by the clinical use of these substances, than with any other dressing. My own experience in the treatment of a large number of cases has convinced me of this, and I feel no hesitancy in using the organic coloring matters on proper wounds.

I take this opportunity of warning against the indiscriminate use of these substances by inexperienced persons, as considerable harm may be done with them by improperly applied, and too long continued, dressings. There is, occasionally an overgrowth of epithelium following the use of these dyestuffs, even when the greatest care is exercised, but after discontinuing the stimulating dressing, this overgrowth soon assumes the level of the normal skin.

The following case shows the epithelial stimulating power of amidoazotoluol to a remarkable degree, and may be of interest.

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[2] Johns Hopkins Hospital Bulletin, vol. xx, No. 219, p. 176; ANNALS OF SURGERY, May, 1911, p. 702; Boston Med. and Surg. Jour., June 6–13, 1912.

Clinical History.—White man, aged thirty years. Engineer. Six months before admission was severely burned in an oil explosion. The head, neck, both upper extremities and portions of the back and chest were involved, and his condition was serious. He was admitted to the Johns Hopkins Hospital in a critical condition and remained there for five months. While in the hospital skin grafting was resorted to a number of times, and considerable progress was made toward healing. He was discharged at his own request before healing was complete, and was referred to the Out-Patient Department for dressings. After several weeks his condition was unimproved, and, as the hospital was crowded, he was sent to the Union Protestant Infirmary, where he came under my care.

Physical Examination.—The patient was anæmic and emaciated. There were large unhealed areas on the scalp and on both arms and forearms. I will describe only the ulcer on the right arm, as this is the particular wound to be considered in this report (Fig. 1).

An extensive granulating wound occupied the entire circumference of the lower two-thirds of the arm, including the elbow and upper two inches of the forearm. The wound extended three inches higher on the outer than on the inner side of the arm. On the inner side an area of skin previously grafted extended up from the forearm to the bend of the elbow. The granulations were exuberant, œdematous and unhealthy. Practically all the skin of the forearm adjacent to the ulcer had been grafted before the patient came under my care. During the interval between admission to the Union Protestant Infirmary and operation on the right arm, the other unhealed areas were grafted.

The granulations of this wound were brought into healthy condition by irrigations, free use of nitrate of silver, balsam of Peru, curved scissors, etc. At the same time very marked progress was also made toward healing by stimulating the wound edges with 4 per cent. amidoazotoluol ointment, alternating every 24–48 hours with zinc oxide, or boric ointment. The newly formed skin edges were thick and stable, but showed no tendency to overgrowth. As the granulations were flat, firm and rose pink in color, in spite of the rapid stimulation of the wound edges, it seemed advisable to hasten the healing by grafting.

Operation (June 28, 1910).—Nitrous oxide-oxygen anæsthesia. A number of large thin Thiersch grafts were obtained from the left thigh by the method used at the Johns Hopkins Hospital,[3] and the grafts were spread on protective and put aside. The thigh was dressed with boric ointment on protective, and the patient was allowed to regain consciousness. The granulating area on the arm was irrigated with salt solution and then dried carefully without causing bleeding. The grafts were button-holed and applied over a large part of the unhealed area. Rubber impregnated mesh was placed snugly over the grafts, and over this overlapping strips of protective, dry gauze and a bandage.

June 30. The dressings were removed down to the rubber mesh, which was not disturbed. The grafted area was irrigated with normal salt solution and dressed with 4 per cent. amidoazotoluol ointment on old linen, over the rubber mesh. This dressing was alternated with boric ointment every 24 hours.

July 12 (after six dressings with 4 per cent. amidoazotoluol ointment). The greater portion of the grafts had taken. Since the last note there had been a remarkable gradual thickening of all the grafts. The surface was smooth but rather uneven, and of a bluish grey color. The appearance was that of an œdematous epithelial mass. The thickness varied between ⅛ and ⅜ of an inch. I felt convinced from my experience with occasional overgrowths of wound edges and other grafts caused by the organic coloring matters, that this thickening would begin to subside as soon as the stimulant should be removed. The thickened grafts were dressed with stearate of zinc powder and exposed to the air, in order to promote drying. The amidoazotoluol was discontinued. There was no excessive thickening of the wound edges.

July 20. The thickening of the grafts was still very marked, but the overgrowth had begun to separate into irregular-shaped fungating masses. When a section was removed for microscopic examination, there was little pain but profuse bleeding (Fig. 2).

July 22. Thiersch grafts from the left thigh were placed on the remaining undisturbed granulations and dressed with moist salt gauze over the rubberized mesh.

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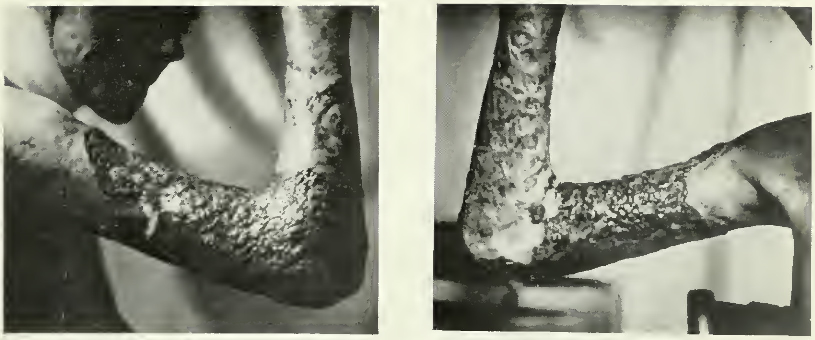
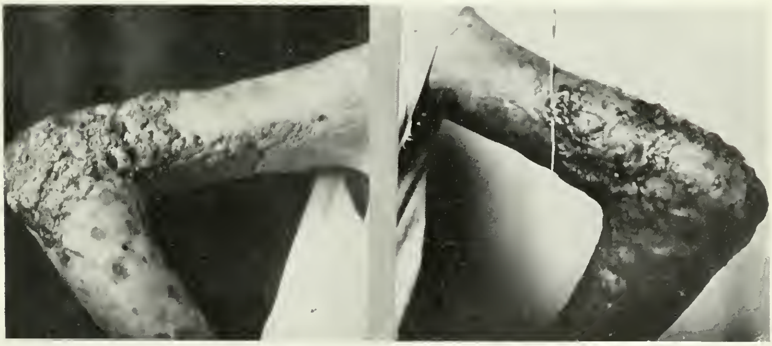
[3] ANNALS OF SURGERY, September, 1909, p. 543.

Fig. 1.



Appearance on admission. Ulcer of right arm due to burn six months previously. Note exuberant, unhealthy granulations. Grafted skin can be seen on the forearm.

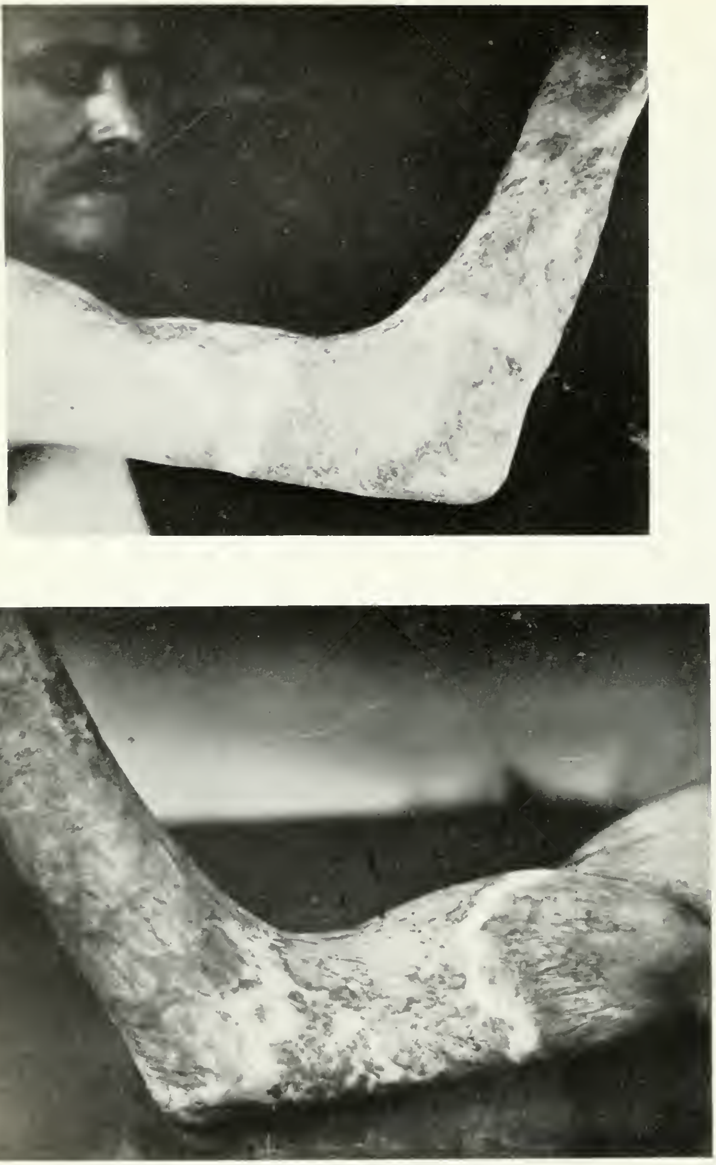
Fig. 2.



(*a*) Taken July 20, 1910. Note the marked thickening of the Thiersch grafts. The thickened grafts have begun to separate into irregular fungating masses which can be plainly seen.

(*b*) Taken August 1, 1910. Portions of the thickened grafts have assumed the level of the normal skin. Over-growth can still be seen in other areas. Note the overgrowth which is attached only by its edges, beneath which a probe is passed. There are a number of similar areas scattered over the arm.

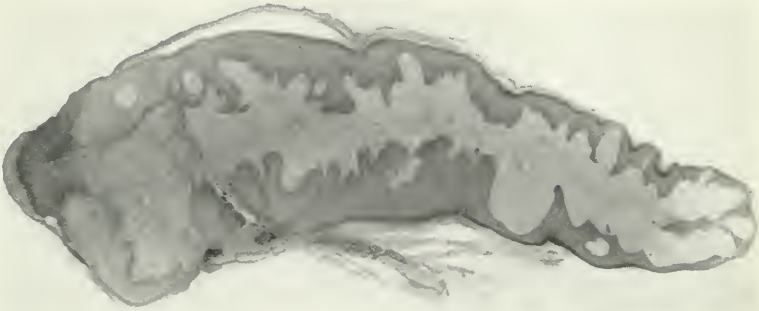
Fig. 3.



(*a*) Taken January 7, 1911. Five months after discharge. The skin is movable and, for the most part, smooth, although several thickened areas can be found. There is considerable pigmentation.

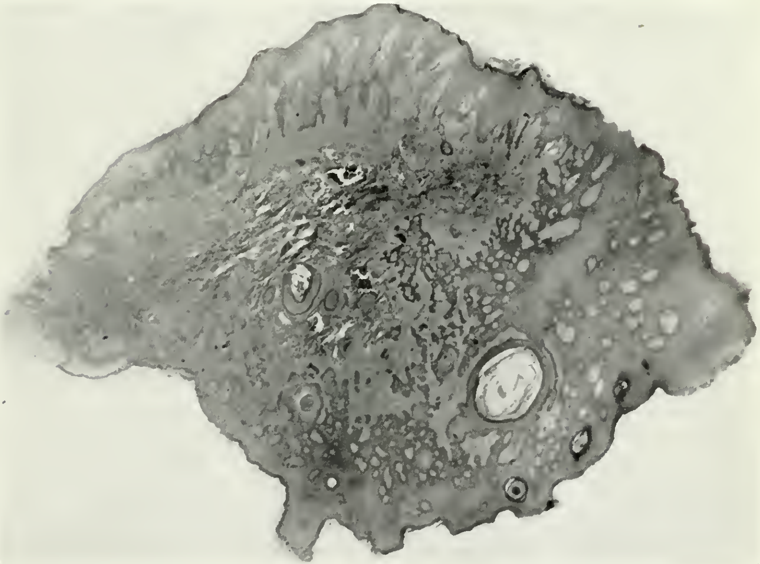
(*b*) Taken January 4, 1912. Seventeen months after discharge. There is marked blotchy pigmentation of the grafted area. On careful examination of this skin one or two small flat thickened areas can be found. There are also a few minute depressions in the skin which are filled with comedon-like masses. Otherwise the skin is normal.

FIG. 4.



Section of small papillomatous overgrowth. For description see text. (Microphotograph by Schapiro, Zeiss. Obj .AA. Oc. 3.)

FIG. 5.



Section of papillomatous overgrowth. For description see text. (Microphotograph by Schapiro. Zeiss. Obj. AA. Oc. 3.)

July 29. All the grafts last applied had taken, and *were of normal thickness,* no amidoazotoluol having been used. The first grafts had resumed, in some places, the appearance of normal grafted skin. In others, several areas had assumed a papillomatous formation. Some of these were of the size of a pea, and were adherent to the underlying clear skin by a small pedicle. Others were flattened mushroom-like masses, with overhanging edges, while other areas were adherent here and there along their edges, and not elsewhere, so that an instrument could be passed freely underneath them. Some of the thickened areas were 1½ inches in diameter, a single portion comprising about one-half of this, and the rest being made up of closely set papillæ, which extended above the surface of the skin from ⅛ to ⅜ of an inch.

Several of these areas were cut off, and normal looking skin was found beneath, except for bleeding at the points of attachment. Here and there masses of cheesy secretion could be pressed from under the overgrown areas, and this had the typical odor of the contents of an atheromatous cyst. Microscopic examination showed this to be made up of epithelial debris.

August 13. Some of the papillary overgrowths had been removed, and many others had dried out and fallen off, as the blood supply of the pedicles was gradually occluded. Those which remained were much less prominent than at the last note. A large part of the thickened grafts had assumed the level of the normal skin, which was of a pinkish color. These level areas gave no evidence of having undergone excessive epithelial stimulation.

The patient was discharged in excellent physical condition, and with practically complete healing of all his lesions.

October 15. The greater part of the grafted skin on the right arm was smooth, but here and there were scattered a few small, flat, dry, papillomatous overgrowths. These growths received their nourishment through very small pedicles, between which the formation was bridged. The patient was working at his usual occupation.

January 7, 1911. Practically all of the papillomatous growths had disappeared, and the area was covered with smooth, solid skin (Fig. 3).

January 14, 1912. The arm was covered with a stable, movable skin, which was heavily pigmentated. On careful examination one or two very small thickened areas could be found on the inner side of the arm. There were also several comedon-like masses which filled minute pockets in the skin.

January 5, 1913. The condition of the skin had not changed since the last note.

Histology.—(Microscopic examination by Dr. Joseph C. Bloodgood.[4]) (Fig. 4.) There was an oblong piece of tissue with a central zone of œdematous connective tissue surrounded by epidermis. The papillary bodies of the epidermis were present. These papillary bodies varied in size and shape; they were larger and more irregular than in the normal epidermis. In some places the hornified epithelium on the surface was more marked than normal. Corresponding to these areas the epidermis was thicker than in areas in which the hornification was less. The epidermis differed from normal in the fact that the basal cell was not so distinct in its morphology, and in places the downgrowth of epidermal epithelium was more irregular than normal. We would speak of it as atypical. In one end of the section the central connective tissue looked myxomatous or œdematous. In the faintly stained intercellular substance there were a few round and stellate connective tissue cells, resembling, therefore, myxomatous tissue. Here and there there was a lymph vessel filled with leucocytes. At the other end of the section there was a defect in the epidermal covering, and this was filled with lymphoid-cell granulation tissue. This granulation tissue grew out from a narrow isthmus in the epidermis, and projected over the surface of the epidermis, like a fungous ulcer. On each side of the granulation tissue in the defect in the epidermis, the epithelial cells were extending irregularly into the granulation tissue. The cell proliferation in the granulating tissue was of the type of the transitional and squamous cell. This histological picture was somewhat similar to that seen in the beginning of carcinoma.

The other piece of tissue (Fig. 5) had the appearance of having been cut on the bias. The central zone of connective tissue was smaller, the epidermis much thicker, and the section seemed to be horizontal through the papillæ rather than vertical. There were also a few cavity formations in the epidermis, filled with hornified epithelium, which had the appearance of the so-called inclusion dermoid cysts. In the connective tissue of this section, there were numerous endothelium-lined canals filled with blood, probably young capillaries, and some more dilated similarly lined spaces filled with blood which may have been veins. There were also some dilated endothelium-lined spaces which suggest lymphatics.

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[4] I take this opportunity of thanking Dr. Bloodgood for the microscopic study.

The entire picture, therefore, suggests unusual epithelial activity. That is, the healing process of epidermization was going on very actively; one would naturally conclude, perhaps too actively, or, as Adami would express it, "over-sufficient." The possibility of producing a definite malignant epithelial growth from such stimulation, as has been observed in X-ray and radium keratosis, should be borne in mind. This possibility is illustrated in the character of the epithelial overgrowth into the granulation tissue filling a defect in the epidermis as noted above. Here the cells were not growing as in normal epidermization in which the downgrowth was always composed first of a basal-cell layer, but, instead, the transitional and squamous cells were proliferating irregularly into the granulation tissue, as in carcinoma. But these cells as yet have not assumed the abnormal morphology seen in cancer.

REMARKS.

The microphotographs, especially Fig. 5, show a condition which resembles very closely sections of the atypical epithelial proliferations produced by injecting scarlet red oil, subcutaneously, under pressure into a rabbit's ear.[5] These experimental tumors never show a tendency to independent aftergrowth, and persist only as long as the injections are continued and the scarlet red remains in the tissues.

The epithelium of this patient seemed to be particularly responsive to the stimulation of amidoazotoluol, and these thickened grafts present the most remarkable condition of overgrowth which has come under my observation.

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[5] F. H. Helmholz: J. H. H. Bull., Sept., 1907, p. 365, Fig. 2, Exp. Ia.

It is interesting to note that Thiersch grafts which were subsequently applied to unhealed portions of the same wound, under exactly the same conditions, but without being dressed with amidoazotoluol were not thickened.

There was also great thickening of the deep pinch grafts placed on the undisturbed granulations of the ulcer on the scalp, which had been treated with amidoazotoluol before and after the application of the grafts. There was no such thickening, however, of similar grafts placed on undisturbed granulations, when not dressed with amidoazotoluol. There was distinct overgrowth of epithelium, " pebbly formation," on the thigh, when the area from which the Thiersch grafts were removed was dressed with amidoazotoluol ointment. Another area on the thigh from which Thiersch grafts were taken, but which was dressed with boric ointment, showed no " pebbly formation."

The patient has been under observation for over two years and a half since his discharge from the hospital, and there is no sign of malignant degeneration anywhere.

This condition is unique, and I can find no report in the literature of a similar case. It demonstrates beyond a doubt the epithelial stimulating power of amidoazotoluol. It also seems to show that although this stimulation is excessive, there is no tendency to subsequent malignant degeneration.

EMBOLISM AND THROMBOSIS OF THE SUPERIOR MESENTERIC ARTERY.*

A REPORT OF ONE CASE.

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AND
FRED C. WATSON, M.D.,
Colon Hospital.

THE comparative rarity of this condition, the difficulty, if not impossibility, of diagnosis before operation, and the extremely high mortality are deemed sufficient reasons for the presentation of this paper.

CASE REPORT.—Case No. 28888, W.N.R. Jamaican, male, black, age fifty-eight, blacksmith; on Isthmus 30 years; admitted to Colon Hospital December 20, 1910, at 12.40 P.M.

Past History.—Patient has had a right inguinal hernia for two years and at times has had considerable difficulty in reducing it.

Present Illness.—Two days before admission a large mass descended into the right side of the scrotum. Patient says he was unable to reduce it, and paid no further attention to it until the morning of his admission to the hospital, when he felt excruciating pain in the abdomen, most marked along the right inguinal canal.

Later there were short intervals when the patient was fairly comfortable, but for the most part the pain was constant and severe. Soon after the onset of pain there was nausea and vomiting. Patient has had no movement of the bowel for two days.

Physical Examination.—Patient well developed and well nourished. Was very restless, constantly groaning, and had some hiccough. The abdomen was distended and very rigid. There was a tender mass in the right inguinal region the size of an orange. An examination of the heart revealed a loud, blowing, systolic murmur best heard over the aortic region. Lungs negative. Temperature on admission was 98° F.; pulse, 108, thready. The urinary examination showed a large amount of albumin and many hyaline casts. A diagnosis of strangulated inguinal hernia was made.

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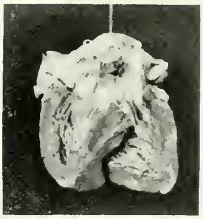
* Read before the Medical Association of the Canal Zone, January 18, 1913. (From the Surgical Clinic at Colon Hospital, Cristobal, C. Z.)

Operation.—December 20, 2.30 P.M. Ether anæsthesia. Inguinal incision. There was no strangulation at either ring. On opening the sac a small coil of gangrenous gut was revealed. As the condition was plainly not due to strangulation, the incision was enlarged upward, revealing numerous similarly affected coils of small intestine. The gangrenous area involved about eight feet of the ileum, extending to within five inches of the ileocæcal valve. (The area supplied by that portion of the superior mesenteric artery distal to the ileocolic branch.) There was a sharply defined line of demarcation above and below. In many places the wall of the gut was quite thin, although no definite perforations could be demonstrated. The mesentery was thick and œdematous with its vessels standing out like firm, hard cords. The peritoneal cavity contained at least 2000 c.c. of thin bloody fluid, very offensive in odor. The peritoneum was markedly injected. There were no adhesions. The condition was evidently a hemorrhagic infarction with gangrene. The involved gut with its mesentery was resected, the edges of the mesentery were united with interrupted catgut sutures and a Murphy button anastomosis performed. The button was reinforced with a closely approximated circle of Lembert sutures. Split tubes were inserted for drainage and the wound closed. The patient left the operating room in fairly good condition, and for three days after the operation his general condition was fairly satisfactory. The temperature ranged between 99.5° and 101°. The pulse did not exceed 110. There was no further vomiting and little or no distention. On the third day there were two voluntary movements of the bowel. On the fourth day there developed marked distention and rigidity of the abdomen with hiccough and a gradual rise of temperature and pulse. The patient died at 12.30 P.M., December 24.

Upon examination of the resected area the gut was found to be gangrenous and filled with a dark bloody fluid. Numerous ulcerations of the mucous membrane were noted. The mesen-

Fig. 1.



Vegetative thrombus just above aortic valve.

tery was thick and its layers were filled with extravasated blood. The lumen of the arterial branches was completely filled with a firmly organized clot. The veins were distended, although they were not occluded. We were unable to determine whether the condition was a primary thrombosis of the superior mesenteric artery or an embolism with a secondary thrombosis. In the light of the findings at autopsy, however, we are inclined to accept the latter view.

An autopsy performed December 24, 1910, 5 P.M., four and one-half hours after death, showed the pericardial and pleural cavities to be negative. The peritoneal cavity contained a considerable quantity of pus and yellowish purulent exudate covered the visceral and parietal layers. There was no attempt at union at the site of the anastomosis and leaking had occurred. The heart showed hypertrophy of the left ventricle and some dilatation of all the chambers. Situated just above the aortic valve was a vegetative thrombus the size of a ten-cent piece. (Fig. 1.) The arch of the aorta was thickened and roughened by the presence of numerous atheromatous plaques. The rest of the aorta was similarly, though less markedly, involved. The other vessels were thickened and showed a loss of elasticity. The lungs showed a few scattered areas of bronchopneumonia in the lower lobes. The spleen was somewhat enlarged and its capsule thickened. On section two small red infarcts were demonstrated. The liver was about two-thirds the normal size, chestnut brown in color, and its surface roughened by numerous minute depressions. On section the interstitial tissue was much increased. The gall-bladder and its ducts, the stomach and pancreas, showed nothing abnormal. The kidneys were normal in size, hard and resistant to the knife. The capsule stripped with difficulty, coming off in two layers. The surface exposed was pale and granular. An occasional small cyst filled with clear, straw-colored fluid was noted. The cortex was somewhat reduced. The kidney architecture, while indistinct in some places, for the most part was good. The pia-arachnoid was markedly œdematous. In the right frontal lobe there was an area of softening the size of an English walnut.

As to the frequency of thrombosis of the superior mesenteric artery alone, Merkel [1] states that there are over 150 cases on record, fatal in nearly every instance.

Etiology.—The same factors which lead to embolism and thrombosis in general may occasion embolism and thrombosis of the superior mesenteric artery. Among the most common causes may be mentioned arteriosclerosis and endocarditis. It occurs most frequently in men past middle life.

Pathology.—According to Welch [2] the usual effect of occlusion of the superior mesenteric artery is hemorrhagic infarction of the small intestine, corresponding to the distribution of the involved vessels. The intestinal wall is thickened, œdematous, and of a dark red color, and covered with lustreless peritoneum. There is usually a sharp line of demarcation, although the margins of the infarct may pass gradually into the healthy bowel. Jackson, Porter and Quinby,[3] in their elaborate presentation of this subject, state that in three-fifths of the cases a line of demarcation is present. Their study was based upon a series of 214 cases of mesenteric embolism and thrombosis, and included practically all of the reported cases up to the year 1904. (Both arterial and venous varieties included.) In rare instances the gut may be gangrenous without typical hemorrhagic infarction. The mucous membrane may or may not be necrotic and perforations with general peritonitis may be present. The lumen of the bowel is distended with dark, tarry blood. The peritoneal cavity usually contains considerable amount of bloody fluid. The mesentery is thick and œdematous with small hemorrhages scattered here and there. In some cases the hemorrhagic extravasation may be so extensive that an abdominal tumor is simulated as in the case recently reported by Thévenot and Rey.[4] The mesenteric glands are often swollen. While hemorrhagic infarction of the small intestine is the usual result of closure of the superior mesenteric artery, the occlusion may take place so slowly that no serious effects are noted, due to the establishment of a collateral circulation. Such a favorable termination may be effected through what has been termed the "subperitoneal arterial plexus." This plexus was described by Sir William Turner [5] in 1863. It communicated on the one hand with the arteries of the abdominal viscera, and, on the other, with the arteries of the different parts of the abdominal wall, such as the phrenic, intercostals and lumbar. In regard to the mesenteric vessels, he states:

"It (this plexus) passed downward between the folds of the mesentery, reaching as far as the coils of the small intestine and communicated with the branches of the superior mesenteric artery." According to DaCosta[6] an adequate collateral circulation occurs in about 5 per cent. of cases.

Symptomatology and Diagnosis.—There is no symptom complex characteristic of this condition. The diagnosis is rarely made before operation and can only be made by exclusion. Fortunately the indications for an exploratory operation are so imperative that such a refinement is unnecessary. Eisendrath[7] says it must be differentiated from the various forms of intestinal obstruction, perforations of gastric and duodenal ulcers, acute cholecystitis or appendicitis associated with acute peritonitis and the rare condition of angina sclerotica abdominis. Shoemaker[8] also includes acute pancreatitis, lead or renal colic, torsion of tumors and referred pain from pneumonia or pleurisy, especially diaphragmatic pleurisy. The condition most closely simulated is intussusception. Intussusception in 56 per cent. of cases occurs in children from the fourth month to the tenth year or in young adults,[9] while embolism or thrombosis of the superior mesenteric artery usually occurs in men past middle life and in those presenting evidence of cardiac or vascular disease. Intestinal hemorrhage is common in both, but it is more apt to be profuse in the embolic cases. A swollen and tympanitic abdomen is rare in the early stages of intussusception, while it occurs in nearly one-half of the cases of embolism.[3] In intussusception a tumor is more often demonstrable. Ordinarily the disease begins in one of two ways: (*a*) This form closely simulates intestinal obstruction with or without general peritonitis. It is characterized by sudden, agonizing abdominal pain, which is usually generalized and paroxysmal. Nausea and vomiting quickly follow and there is absolute constipation. If the occlusion in the artery is high up the vomitus may consist entirely of blood. The abdomen is much distended, tender and rigid. (*b*) This form is characterized by a predominance of the symptoms of intestinal hemorrhage. The patient is greatly prostrated, there are severe colicky pains and frequent bloody stools. In the early stages the symptoms of intestinal paralysis are usually less marked. In addition to these generally accepted and more common types there is a chronic form characterized by a more insidious onset and which may give rise to a large blood tumor between the layers of the mesentery. This form must be differentiated from cysts of the mesentery and other abdominal tumors.[10] According to Gerhardt [11] a typical case of embolism or thrombosis of the superior mesenteric artery should present the following features: A source for the embolus, profuse intestinal hemorrhage unaccounted for by a lesion of the intestinal wall or obstruction to the portal circulation, the characteristic paroxysmal pain, ileus and the presence of fluid in the abdomen, a rapid fall in the temperature, and the presence of a large palpable mass between the layers of the mesentery.

Prognosis.—In rare instances a collateral circulation may be established and spontaneous cure take place. Of the series reported by Jackson, Porter and Quinby,[3] 47 were subjected to operation and only 4 recovered, giving a mortality of 92 per cent. With an early exploratory operation the mortality may be materially reduced.

Treatment.—If the patient's general condition is good and there is present a sharp line of demarcation, a resection of the involved area with immediate intestinal anastomosis—preferably by a lateral method—would seem to be the ideal method of procedure. If this is impossible on account of a less favorable condition of the patient and there is no well-marked line of demarcation, a resection with the establishment of a temporary artificial anus would be the method of choice. Peritonitis as a complication should receive appropriate treatment.

We desire to thank Col. W. C. Gorgas, Chief Sanitary Officer, Isthmian Canal Commission, for permission to publish this paper.

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THE CAUSE AND TREATMENT OF CERTAIN UNFAVORABLE AFTER-EFFECTS OF GASTRO-ENTEROSTOMY.*

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OF LONDON.

Assistant Physician to Guy's Hospital.

As a result of modern improvements in technic, the unfavorable complications, which were formerly not infrequent after gastro-enterostomy, have become more and more rare. It must, however, have been the experience of almost every surgeon that patients, upon whom a gastro-enterostomy had been performed, have at some later period complained of symptoms, which were often trivial in comparison with those of the condition for which the operation was carried out, but which were none the less sufficient to prevent the patient from regarding the result of the operation as entirely satisfactory. In the last few years I have been consulted by a considerable number of such patients, at intervals varying from a few weeks to several years after the operation, which had been performed for various conditions, but most commonly for duodenal ulcer. I have gradually come to recognize that the symptoms in a considerable proportion of the cases are due to a cause which has not hitherto been described, and in others are the result of a condition which has, up to now, only been incidentally referred to by Jonas,[2] in 1908. These two conditions, which I propose to discuss more fully in this paper, are in my experience considerably more common than is the recurrence of ulceration in the duodenum, the closure of the stoma or the formation of jejunal or gastrojejunal ulcer. They occur, of course, in only a small proportion of all the cases operated upon. I have seen about twenty cases, which have been operated upon by almost as many different surgeons; they therefore represent a very small percentage of cases in the practice of each individual surgeon. They are, none the less, of considerable importance, as their recognition and treatment often results in the conversion of a comparatively unsuccessful case into a completely successful one.

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* Founded on a paper read before the Surgical Section of the Royal Society of Medicine, February 11, 1913.

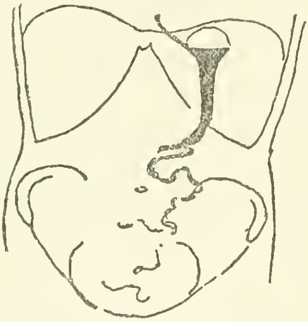
1. *Too Rapid Drainage of the Stomach.*—The patient complains of a sensation of fulness, which occurs during each meal, and which may be so unpleasant that the amount of food taken is progressively diminished and a considerable loss of weight may finally occur. The sensation disappears rapidly, and the patient may find that by eating with extreme slowness he is able to prevent its occurrence. Many patients recognize that this sense of fulness is localized slightly lower than the position where the pain or discomfort, for which the operation was performed, was felt.

In some cases the patient also complains of slight diarrhœa, the bowels being opened after each meal; the first stool passed in the day is generally solid, but the later ones are unformed and occasionally fluid. In rare cases the diarrhœa may be severe, and a case which has been reported of a patient dying from diarrhœa after gastro-enterostomy was probably of this nature, no organic cause having been discovered at the autopsy.

In all patients suffering from this group of symptoms I have found with the X-rays that the stomach was small and hypertonic and that the passage of food out of it was extremely rapid, so that a meal, consisting of half a pint of porridge and milk mixed with two ounces of bismuth oxychloride or barium sulphate, left the stomach in less than an hour, and in one case in less than ten minutes after being taken, instead of requiring the normal three or four hours. If the patient is watched whilst he is taking the meal, the outflow from the stoma may indeed appear to be almost as rapid as the inflow from the œsophagus (Fig. 1). In all cases little or nothing passed through the pylorus, and sometimes the chyme even failed to reach the portion of the pyloric end of the stomach beyond the stoma. The rapidity of escape through the stoma does not depend upon the condition of the pylorus, as I have seen more cases in which the pylorus was left patent at the operation than cases in which the pylorus was obstructed as a result of disease or by the surgeon in the course of the operation. Indeed, the most marked case I have ever seen was one in which the stomach was completely empty less than ten minutes after a bismuth meal was begun, and the pyloric passage had actually been widened by means of pyloroplasty at the second operation, which was performed on account of persistence of the symptoms before I saw the patient.

The rapid passage of the gastric contents through the stoma leads to distention of the proximal part of the jejunum in a way which never occurs normally, as the duodenum and end of the ileum are the only parts of the small intestine which are ever full under natural conditions. I believe this distention of the jejunum is the cause of the sense of fulness, as the experiments described in my Goulstonian Lectures proved that distention, which leads to stretching of the muscle-fibres, is the only adequate stimulus of visceral sensation. In confirmation of this, the situation of the sensation is found to be lower than that due to gastric distention, and corresponds to the upper limit of the situation of the pain felt when the small intestine is subjected to rapid distention. The patient sometimes finds that anything which increases the activity of

Fig. 1.



Five years after gastro-enterostomy for small duodenal ulcer, which did not produce obstruction.

the small intestine, such as exercise or a dose of castor-oil, though it may increase the discomfort, makes it disappear more rapidly than it would otherwise, doubtless because the distention of the jejunum lasts for a shorter period.

Confusion with the symptoms arising from a jejunal or gastrojejunal ulcer is prevented by the fact that the nature of the diet has a considerable influence on the latter, whereas, in this type of this post-operative indigestion, the quantity and not the quality of the food is alone of importance.

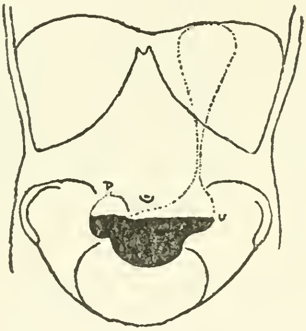
The diarrhœa is mainly due to the irritation of the bowels by the food, which escapes from the stomach too rapidly for efficient gastric digestion; owing to the absence of the normal stimulation of pancreatic secretion by hydrochloric acid in the duodenum it does not undergo sufficient compensatory digestion in the intestine. It tends to occur after meals owing to the normal gastrocolic reflex, which I have shown leads to an increase in the peristalsis of the colon whenever food enters the stomach.[1] In all probability there is also an enterocolic reflex, which arises from distention of the jejunum and produces the same result.

Complete relief or considerable improvement occurs if the patient is instructed to lie down for half an hour or an hour after each meal, as it is found with the X-rays that the stomach empties itself much less rapidly when this posture is assumed, the stoma no longer being in the most dependent position. In some cases it is better to lie on the right or less frequently on the left side, the best position being easily ascertained by watching the rate of evacuation with the X-rays. The patient should also be given some active preparation of pancreatic ferments, such as pankreon, at each meal, in order to compensate for the deficiency of the normal secretions. If the sense of fulness is still experienced, in spite of the treatment I have described, small doses of belladonna, which causes the involuntary muscle-fibres of the intestines to relax, and of codeine, which diminishes the excitability of the visceral nervous system, should be given half an hour before meals.

If all treatment fails to give relief and the patient's symptoms are severe, it might perhaps be necessary to perform an operation with the object of diminishing the size of the stoma, or, if the pylorus is not obstructed, of restoring its activity by completely closing the stoma. The interesting question also arises whether surgeons have not gone somewhat too far in their desire to obtain sufficient drainage, and whether it would not be advisable in the future to make a somewhat smaller stoma than has commonly been made in the last few years.

2. *Situation of the Stoma above the Upper Level of the Gastric Contents.*—In cases of extreme dilatation of the stomach I have, on a number of occasions, observed that in the vertical position the whole of the gastric contents accumulate in the lowest part of the stomach in such a way that their upper limit is below the pylorus, and may not even reach the lesser curvature (Fig. 2). In such cases nothing at all can leave the pylorus, however strong peristalsis is, until the patient lies down. It is clear that in such cases an effective gastro-enterostomy must have the stoma so situated that it remains in the most dependent part of the stomach even when the vertical position is assumed. When the stomach is extremely dilated it must be exceedingly difficult to judge at an operation which will be the most dependent part when the vertical position is assumed, as, quite apart from any dilata-

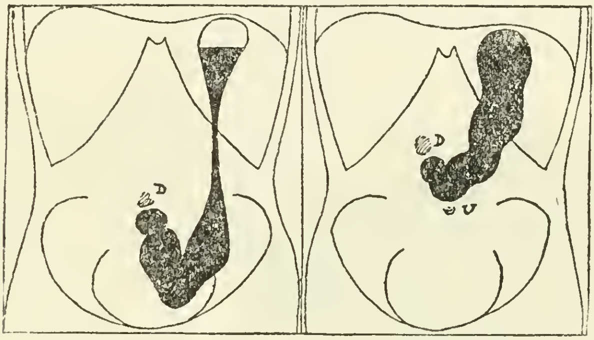
FIG. 2.



Pyloric obstruction due to duodenal ulcer; dilatation and hypertrophy of stomach. *P*, pylorus *U*, upper level of gastric contents.

tion, the influence of posture on the position of the stomach may be remarkably great (Fig. 3). Fortunately, the rest in bed and the strict diet after the operation are a great safeguard; whilst lying down the stomach drains quite satisfactorily through the stoma, and consequently regains a great deal of its tone. I have, however, seen one case of dilated stomach due to simple pyloric obstruction, in which no improvement resulted from operation, and in which we found that in the vertical position the upper limit of the gastric contents did not reach as high as the stoma or the pylorus (Fig. 4), but that on compressing the lower part of the abdo-

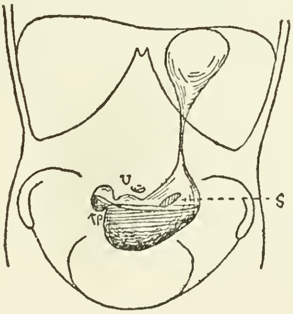
Fig. 3.



Vertical position. Horizontal position.

Gastroptosis. *D*, duodenum; *U*, umbilicus.

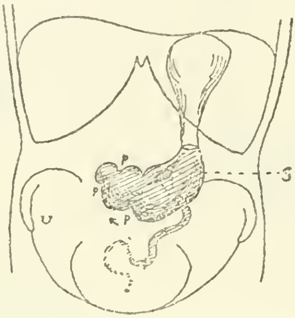
Fig. 4.



Gastro-enterostomy for pyloric obstruction. Stoma above the upper limit of the gastric contents in the vertical position. *U*, umbilicus; *P*, peristaltic waves; *S*, stoma.

men the contents rose above the stoma and at once began to pass out of it (Fig. 5). By supplying the patient with an abdominal support and making him lie down for an hour after meals on his left side—the position in which I found that the drainage was most rapid—complete relief was eventually obtained. A somewhat similar case has been described by Jonas.

FIG. 5.



Same case as Fig. 4, with abdomen compressed so that the gastric contents can pass out of the stoma.

I believe that the notorious absence of success of gastro-enterostomy, when performed for severe atonic dilatation of the stomach without organic obstruction, must be due to a similar cause, drainage through the stoma being mechanically impossible.

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RECTUS TRANSPLANTATION FOR DEFICIENCY OF INTERNAL OBLIQUE MUSCLE, IN CERTAIN CASES OF INGUINAL HERNIA.*

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THE desirability of including muscle in the suture of abdominal wounds in addition to fascial and aponeurotic structures, not only to secure as broad a union as possible but to counteract the stretching of the union of fascia and aponeuroses, has long been recognized in guarding against hernial separation.

From time to time patients with the inguinal variety of hernia present themselves in whom the internal oblique muscle is markedly deficient; in some the transversalis fascia at the base of Hesselbach's triangle is thin to the point of obliteration as well, and when the external oblique aponeurosis is divided three or four fingers can be pushed into the abdomen, invaginating the atrophic transversalis fascia, properitoneal tissue, and peritoneum. The protrusion at the internal ring may extend for several fingers' breadth toward the pubes, thinning out the ligamentum inguinalis mediale of the transversalis fascia and possibly even extending to the inner vertical fibres. The transversalis aponeurosis, normally deficient for a short distance above Poupart's ligament in the region of the inguinal canal, is not only thin but narrow in these cases. It can rarely, if at all, be utilized in the Bassini operation.

A discussion of the anatomy of the inguinal region is hardly in place at this date when the so-called conjoined tendon is so generally recognized as a myth, as far as its usefulness in the Bassini operation is concerned, and the internal oblique recognized as our mainstay, forming as it does so much of the anterior wall of the inguinal canal. Even the transversalis muscle, except in sutures placed well out toward the internal ring, is not included in the repair.

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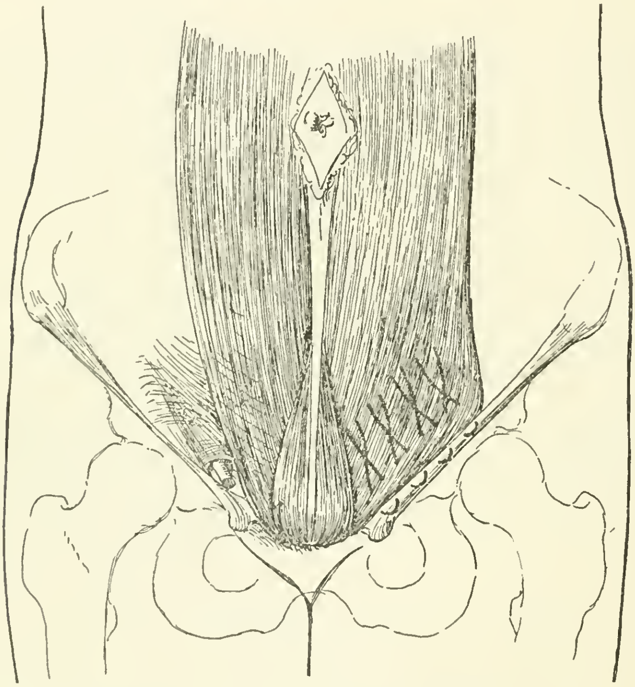
* Read before the New York Surgical Society, April 23, 1913.

While many hernial recurrences take place through the internal ring rather than through the transversalis fascia as a direct hernia, a sufficient number do recur in this way to make the support of this weak area, internal to the transplanted cord, especially important in those doing heavy manual labor and in whom the internal oblique muscle is insufficient for adequate protection. Not a few of these cases with weak transversalis fascia and large herniæ have, nevertheless, a good internal oblique, quite sufficient for the Bassini operation without embellishments. Some of them have not. On the other hand, there are those with but moderate sized herniæ who are markedly deficient in oblique muscle, there being scarcely more than enough to insert the external suture of

Fig. 1.



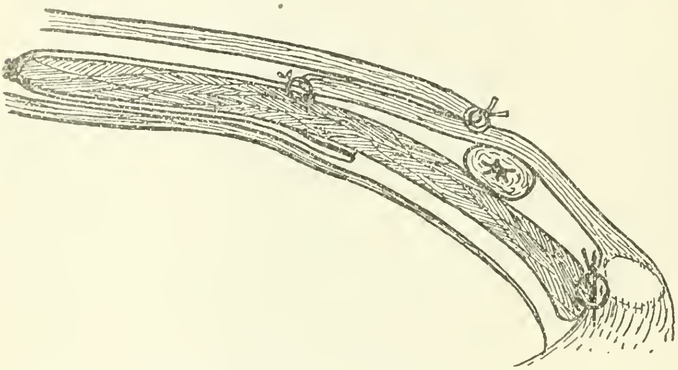
Deviation of fibres of rectus (after Bloodgood).

Coley beyond the cord. For these cases, a few only of the total number (Bloodgood states as high as 7 per cent.), the transplantation of the nearby muscle of the rectus has served extremely well.

The literature upon the subject of rectus transplantation is not voluminous and in it but little distinction has been drawn between the different anatomical conditions and the operative procedure most applicable to each. The procedure, usually spoken of in this country as Bloodgood's and published by him in 1898, is not altogether of this late date. Bassini, in his original communication in 1890, recommended suture of the lower border of the rectus to Poupart's ligament in the two or three sutures taken nearest the pubes. Wölfler, in 1892, reported in *Billroth's Festschrift,* 51 of 58 cases done by a complicated technic of his own in which the cord was transplanted back of the rectus, the internal oblique sutured to Poupart's ligament, and lastly the rectus drawn out of its sheath anteriorly and sutured to Poupart's ligament as well. This anterior opening of the rectus sheath weakens the internal attachment of the already sutured internal oblique if it be well developed. The transplantation in his cases as a routine seems unwarranted, as the internal oblique was sufficient for the typical Bassini. The recurrences were about 5 per cent. Bloodgood more recently has opened the rectus sheath from behind, obviating this disturbance of the internal attachment of the muscle. Slajmer, in 1898, reported 150 cases done by a modified Wölfler method without cord transplantation. After freeing the layers his outer two sutures bring the internal oblique to Poupart's ligament, the next two the outer part of the anterior sheath of the rectus and the rectus muscle edge to Poupart's ligament and the external oblique fascia, and the last two the inner edge of the rectus sheath and external oblique fascia. Two final sutures close the external ring. This method is open to much the same objection as the preceding. The recurrences were about 4 per cent. The adaptation of the rectus transplantation to the Halsted operation was Bloodgood's, and in 14 cases, of an early communication, where it was done in the presence of obliterated transversalis fascia, there were no relapses at the lower end of the wound, while 62 per cent. of similar cases done by the Halsted operation alone recurred. Its adjuvant effect in this operation is therefore marked, when indicated.

We have the choice of a number of operative procedures, depending upon the anatomical condition and based upon or combined with the Bassini operation. In the presence of a good internal oblique muscle, its internal attachment is weakened if the rectus sheath is opened anteriorly, and this is contra-indicated both in direct and in indirect herniæ; for the indirect, the straight Bassini is sufficient, and for the direct many times as well. In *deficiency* of the internal oblique, rectus transplantation with or without utilizing the remaining portion of the oblique, as an additional Bassini, is of assistance both in direct and indirect herniæ. In moderate-sized indirect and direct herniæ with marked oblique deficiency, the rectus sheath may be opened anteriorly and the muscle transplanted in a manner I wish to speak of later, and that has proved very simple and most satisfactory in some 12 cases. In the larger herniæ indirect and direct with oblique deficiency, we have but scanty structures to interpose, and rectus transplantation is at its maximum of usefulness. The sheath

FIG. 2.



Schematic diagram of arrangement of rectus and external oblique fascia.

should be opened behind the attachment of the internal oblique and transversalis aponeurosis, and the muscle brought down to Poupart's ligament, what is left of the internal oblique sutured to the ligament as well and the external oblique fascia over all. In all cases, where there is *sufficient* internal oblique muscle to use internally to the transplanted cord, it seems wiser to open the rectus sheath from behind, and bring the muscle down behind the oblique. In marked deficiency of the oblique, little or no harm results from opening the sheath in front.

Downes, in a number of these cases of direct hernia and of hernia recurring after operation through the transversalis fascia, has done this combined operation; Blake, at a somewhat earlier date, as well. The Mayos, in similar cases, have utilized what remained of the internal oblique and sutured this together with external oblique aponeurosis well down on the sloping shelf of Poupart's ligament, the outer half of the external oblique muscle and fascia overlapping the line of union and the internal half. They do not expect over 1 per cent. recurrence. Halsted has turned down a flap from the anterior sheath of the rectus. Berger, in 1902, did the same. The use of muscle tissue in addition to aponeurotic structure seems the method of choice.

Transplantation, or transposition, of the lower part of the rectus muscle does not markedly alter the direction of its fibres, or result in tension on suturing, if an adequate opening be made in the sheath. Furthermore, as remarked by Russell, the new relations of the rectus formed materially aid in maintaining its new position. The method I have followed in some 12 cases of indirect hernia, with markedly deficient internal oblique and weak transversalis fascia, has been to first utilize what remains of the oblique muscle, usually only that part external to the internal ring and transplanted cord, by inserting Coley's stitch. The rectus sheath was opened for three inches a quarter of an inch from its edge, the incision beginning below the insertion of the aponeurosis of the remaining good oblique, the muscle loosened from its sheath and drawn down to the thoroughly cleaned shelving edge of Poupart's ligament by four No. 2 or

3, 14-day chromic sutures. The cord lays upon this bed. The outer half of the external oblique aponeurosis is sutured to the internal half of the rectus sheath. This overlaps the line of union of muscle to Poupart's ligament and closes over the rectus muscle. The inner half of the external oblique aponeurosis is drawn down over the line of union of the outer half with the rectus sheath with a few mattress sutures. Externally, one or two sutures of chromic gut bring into close apposition the cut edges of the aponeurosis.

Adequate rest in bed of 20 to 21 days seems proper in all hernia operations, the function of sutures being to bring tissues into apposition for union without strangulation and not to take the mechanical strain which the tissues themselves are capable of doing when properly united by first intention.

All the cases done by this method were heard from or seen over a year later, and a few two years after operation, with the exception of four done since the first of January who were seen within the last week, and repair has been apparently perfect in all.

The various procedures utilizing the rectus muscle have a definite usefulness and indication in a certain number of cases, where the operation is made to fit the condition and not the condition to a typical operation, however good that may be.

RECURRENCE OF INGUINAL HERNIA.

BY A. J. HULL, F.R.C.S. (Eng.), Major, R.A.M.C.,
OF LONDON.

A FEW years ago it was the practice of surgeons when considering the advisability of operating for the radical cure of inguinal hernia, to point out that the operation " only put the clock back " to the conditions of affairs which existed previous to the development of the hernia.

This view is no longer generally held. Surgeons who believe in the presence of an abnormal process of peritoneum being the sole cause of hernia, will, if they follow their belief to its logical conclusion, believe that efficient treatment of the sac will invariably cure the hernia. There is no doubt, however, that hernias treated by efficient ligature of the sac and an additional plastic operation upon the inguinal canal do recur. It is probable that the high percentage of failures published in some statistics is due to the fact that many cases treated by obsolete methods of operating were included and that if a large number of cases could be traced which were operated by modern methods of performing the radical cure the results would show that the operation is one of the most certainly successful in surgery—I am inclined to this view by the fact that I have rarely found that a typical Bassini operation with displacement of cord has been performed when operating for recurrence of hernia after operation.

An examination of the methods of recurrence of hernia will guide us to the most satisfactory operation for its radical cure. The type of relapse is found to follow accurately the type of operation originally performed.

1. If the sac has not been ligatured or sutured sufficiently high up, the hernia rapidly recurs in the sac.

2. Cases operated upon as follows: *a*. Opening inguinal

canal; *b.* ligature of neck of sac; *c.* suture of conjoined tendon over cord to Poupart's ligament.

Recurrence takes place often a year or more after the operation. The hernia appears to the inner side of the internal ring and pushes forward the parietal peritoneum and transversalis fascia.

A section of the inguinal ring shows the weak spot left by this operation. A tent-like space is found by the conjoined tendon stretching across the cord. The internal ring is not constricted. Out of fifty-seven cases of recurrent hernia which have come under my observation, 45 followed the operation indicated above. Hernia to the outer side of the internal ring or direct hernia does not follow this operation.

3. Cases operated upon as follows: *a.* Opening inguinal canal; *b.* ligature of neck of sac; *c.* suture of conjoined tendon beneath cord to Poupart's ligament.

The internal ring is efficiently constricted. Recurrence is rare after this operation and when it occurs it occurs to the outer side of the internal ring.

The case operated upon by the writer recurred four months after operation. Only seven out of fifty-seven recurrences had been operated upon by this method.

4. Cases operated upon by ligature of the sac alone.

Relapse usually follows by a protrusion of the parietal peritoneum through the internal ring, which has not been constricted by the operation, or appears to the inner side of the internal ring.

5. Cases operated upon by ligaturing the neck of the sac and displacing the ligatured neck by buried sutures.

In this method the weakest point of the abdominal wall is transferred from one point to another. Normally the internal ring is the weakest point and if the neck of the sac be displaced outward and a typical Bassini operation performed, the weak point becomes the area immediately to the outer side of the internal ring. The procedure of displacing and burying the neck of the sac is probably one of the most valuable steps in the operation for radical cure of hernia, provided the sac is displaced to the safest possible place, which is above the internal ring.

6. Cases of hernia treated during childhood.

The treatment of hernia in children by trusses frequently effects a temporary cure, a cure which is followed by a relapse sooner or later, when the strain of adult work begins.

From a consideration of the modes of recurrence the following points appear to be necessary in the operation for hernia: *a.* Transposition of the neck of the sac; *b.* constriction of the internal ring; *c.* strengthening the weak area of the posterior wall of the inguinal canal to the inner side of the internal ring. In the typical Bassini operation this is done by suturing the conjoined tendon to Poupart's ligament; *d.* obtaining adequate pressure upon the internal ring; *e.* strengthening the weak area to the outer side of the internal ring.

In the following operation which I now perform and which has been adopted by my colleagues, the above points are embodied.

The inguinal canal is opened by dividing the external oblique over the canal from the external ring to well above the internal ring.

The coverings of the spermatic cord are lifted with two pairs of forceps and divided between the forceps by a knife the edge of which is lateralized.

The sac is recognized and separated from the constituents of the cord. The neck of the sac is carefully isolated by stripping structure adherent to it by wiping it with dry gauze. The sac is transferred and ligatured as high up as possible, the ligatures are left long and one of the ends is threaded through a needle the point of the needle protected by a finger is passed through the internal ring and brought out through the entire thickness of the abdominal wall, with the exception of the skin about one and a half inches above the internal ring. The other end is treated in the same way and the ends tied together.

The next step is to constrict the internal ring and strengthen the posterior wall of the inguinal canal. This is done by separating the two muscles forming the conjoined tendon and having lifted the cord, suturing the transversalis muscle and conjoined tendon to Poupart's ligament.

The internal oblique is now sutured over the cord to Poupart's ligament, commencing about one inch and a half to the outer side of the internal ring.

By this step the area to the outer side of the internal ring, where relapse occasionally occurs, is strengthened, adequate muscular pressure is obtained over the internal ring and the pressure of the transversalis which now forms the posterior wall of the inguinal canal is reinforced. The spermatic cord now passes between the two muscles which form the conjoined tendon and a recurrence of hernia along the cord is efficiently prevented. It is rarely necessary to lessen the size of the cord by removing some of the veins and coverings. Fishing gut sutures are employed for these deep stitches, the knot is tied three times and the ends cut short. No after trouble appears to occur from the use of these hard and unabsorbable sutures —I have used kangaroo tendon in many cases but consider ordinary fishing gut a better suture.

The inguinal canal is closed by suturing the divided aponeurosis of the external oblique.

CONTRACTURE OF THE PSOAS PARVUS MUSCLE SIMULATING APPENDICITIS.*

BY GEORGE R. WHITE, M.D.,

OF SAVANNAH, GA.

Among the cases operated upon for appendicitis there are a certain number in which the removal of the appendix does not relieve the symptoms, and the patients have no abatement of pain and tenderness in the right iliac fossa after the operation. There are several causes assigned for continuance of the pain, including adhesions, Jackson's veil, ptosis of the colon, and functional neurosis. After some observations, extending over about five years, it is my belief that contractures of this psoas parvus sometimes occur, simulating chronic appendicitis and keeping up trouble after the appendix has been removed.

The first case that called my attention to this condition was a patient of Dr. M. L. Currie, of Vidalia, in his hospital, in November, 1908. The history is briefly as follows:

Case I.—Mrs. O. P., thirty-eight years, married, no children. Well nourished and not of a neurotic temperament. About a year previously she began to have shooting pains and tenderness in the right iliac fossa, which gradually got worse. Six weeks ago the pain was so great she was obliged to take to her bed, where she has remained. She was not constipated, there were no digestive disturbances, and there was never any fever. Examination showed the four classical symptoms of appendicitis—rigidity of the right abdominal muscles, localized pain, excessive tenderness over McBurney's point, and a distinct tumor in the region of the appendix, which could not be well defined on account of rigidity and excessive tenderness. A diagnosis of appendicitis was made. At operation the appendix was found to be small, soft and apparently normal in every way. The mesentery was long and there were no adhesions about the caput coli, nor anything that would indicate an inflammatory process in that neighborhood. The tumor, which we had felt before the operation, was found to be a tense band of fascia along the inner side of the psoas magnus, attached to the borders of the upper lumbar vertebræ and below to the pelvis.

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* Read before the Georgia Medical Association, April 16, 1913.

An opening was made through the posterior parietal peritoneum and the band cut. So great was the tension it snapped loud enough to be heard by the assistants. Additional bands of fascia running through the psoas magnus were incised and all tensions relieved. The patient made an uneventful recovery, and went home two weeks after the operation.

A letter from Dr. Currie, dated March 28, 1912, three and a half years after the operation, states that relief was complete and permanent.

The next case occurred about two years later.

Case II.—January 19, 1911, B. W., twenty-seven years, married, three children. Patient is a healthy country woman, not of a nervous temperament.

Two years ago, about two months before confinement, she was taken with a sudden severe pain in the right iliac fossa. It partially subsided in a few minutes, but the side remained painful and tender. After delivery the pain gradually increased and became so great that she has been an invalid for the past year and a half, spending most of her time in bed. The pain, which starts from the right iliac fossa, extends down the leg, up to the shoulder, and sometimes to the opposite side. She walks bent over, and lies on the right side with the legs drawn up. She has indigestion and is constipated, but has had no fever.

Examination shows a flaccid abdomen with no rigidity of the muscles. There is a tumor in the right iliac fossa, which could not be palpated satisfactorily on account of extreme tenderness. The pelvic organs were negative. The right kidney is movable. Passive motion of the leg is painless. From experience with the previous case, the diagnosis was made before the operation. The appendix was found normal with no evidence of inflammation in the neighborhood.

The psoas parvus was found in a state of contracture and projected forward into the abdominal cavity, resembling a tumor. The main tendon together with several accessory bands were incised, relieving all tension. Immediate relief followed the operation. She went home in about two weeks and was able to get about with some degree of comfort.

August 11, 1911, she returned and the floating kidney was anchored. A letter dated March 27, 1912, states that she was greatly benefited by the operations and is now enjoying good health, and is able to do her work.

In spite of experience with the two cases mentioned above, in the third case, which occurred over a year later, the diagnosis was not made and the symptoms relieved until the third operation had been performed.

Case III.—October 19, 1911, P. C., fourteen years old, well nourished and not neurotic. In August of this year she began to have shooting pains in the right side, which gradually increased in severity until October 1, when she was confined to bed with a severe pain. There was no constipation, no fever, and no disturbance of digestion.

Examination showed the four classic symptoms of appendicitis; namely, rigidity of the right rectus muscle, localized pain and tenderness in the right iliac fossa, and a tumor. She was operated upon and the appendix removed, but obtained no relief. January 26, 1912, the pain was so great she was again operated upon for adhesions. No adhesions were found and the operation afforded no relief. The pain gradually got worse after the operation, and began shooting down the leg.

March 21, 1912, after several examinations, each showing an indefinite tumor in the right iliac fossa, she was operated upon the third time for contracture of the psoas parvus tendon.

The tendon was exposed retroperitoneally through the usual appendicitis incision, and was found to be very tense, with several bands of fascia running through the psoas magnus. The main and accessory tendons were cut, and all tension relieved.

Relief from pain in the side was prompt. She was able to walk about the room in ten days, and when seen May 1 the side was absolutely free from pain, and she was enjoying good health.

In the fourth case the patient was a neurasthenic and in the absence of any other discoverable cause, the condition might be considered a neurosis.

Case IV.—T. L., single, sixteen years, Jewess. Patient is of a decided nervous temperament and is employed as a telephone exchange operator, a work that exaggerates her neurotic tendencies.

February 21, 1912, while at work she was taken suddenly with a pain in the right side so severe that she fainted. She was taken home and during the next two days suffered intense pain in the right side of the abdomen and down the leg. Vomiting took place soon after the attack and continued at intervals during the next day. There was no rise of temperature. Examination when first seen, three days after the attack, showed great rigidity of the right abdominal muscles, exquisite tenderness over McBurney's point, and an ill defined tumor in the right iliac fossa.

The operation disclosed a perfectly normal appendix, but a tensely contracted psoas parvus muscle. This was cut retroperitoneally with immediate relief.

She was examined April 1, 1912. The side was neither painful nor tender, and she was going about with comfort.

March 4, 1913, the patient was seen again, complaining of pain in the left side, which came on suddenly while at work, and was severe enough to keep her in bed. There was no fever and no digestive disturbance. Examination showed tenderness in the left iliac fossa, rigidity of the left abdominal muscles and a mass in the left iliac fossa, which was diagnosed a contractured psoas parvus. She was seen by Dr. Walter Wilson and Dr. Walter Norton, who confirmed the diagnosis. March 6 she was operated upon the second time. The tendon was exposed retroperitoneally, and was found to be in a state of tense contracture, projecting forward almost like a knife blade. It was incised, relieving all tension. Recovery was uneventful. She left the hospital on the twelfth day, and when seen last, April 13, she was feeling well, and ready to go to work.

This is the only case in the series in which marked involvement of the left tendon has been observed.

Case V.—April 17, 1912, Mrs. S. E. A. The patient is sixty-nine years old and shows the effects of her years. She suffers from indigestion, constipation and neuralgia. Twelve years ago she began to have attacks of pain in the right iliac fossa with neither nausea nor fever. She was seldom entirely free from pain, and at times it became very severe.

Examination showed rigidity of the right rectus, tenderness over McBurney's point, and a tumor about the size of a finger.

The operation revealed a small sclerotic appendix with adhesions, which may have been a factor in causing the trouble. The psoas parvus fascia was in a state of contracture, and projected forward into the abdominal cavity, simulating a tumor.

The main and accessory bands of fascia were cut retroperitoneally and all tension relieved. There has been no pain in the side since the operation, though indigestion and neuralgic attacks continue.

Case VI.—June 12, 1912, A. W., forty-two years. The patient has had rheumatic pains in various parts of the body the past year. For the past month the right side of the abdomen has been painful and tender, with pain increased by movement, so that she was confined to bed most of the time. She was constipated and had severe vomiting spells.

Examination showed rigidity of the right abdominal muscles, tenderness over McBurney's point, and rigidity of the psoas parvus muscle. The muscle in the left iliac fossa was rigid but to a lesser extent.

At operation the appendix was found in a normal condition. The right psoas parvus was in a state of tense contracture and was incised, relieving all tension. The patient was relieved from pain immediately, and was able to return home in two weeks.

Case VII.—Sept. 11, 1912, M. J., twenty-six years. The patient has had a pain in the right side for about eight months, sometimes quite severe. Two weeks ago she had an attack which confined her to bed. She is now feeling better, but the right side is painful and tender.

She is not neurotic and there have been no digestive disturbances and no fever. Examination showed a floating kidney. The abdominal muscles were relaxed and a tense band felt in the right iliac fossa.

The kidney was anchored, the appendix was removed, though it was apparently normal, and the psoas parvus tendon cut.

She made an uneventful recovery, and went home in two weeks.

Besides these marked cases, the condition has been observed in a minor degree and associated with floating kidney, chronic appendicitis, and Jackson's veil, but the tension was apparently not great enough to produce symptoms.

In these seven cases the pathological conditions were practically the same. The psoas parvus tendon was under considerable tension, which was not relieved by an anæsthetic and caused the tendon to project forward toward the abdominal cavity, simulating a tumor when felt through the abdominal walls.

Regarding the etiology and pathology of the condition, I know nothing. Spastic muscular contractures in various parts of the body are well known, those of the neck being the most common. They are usually attributed to functional neurosis, organic disease of the nervous system, syphilis, or rheumatism. Contractures in this locality are not discussed in available literature. All I can find is the following:

Writing upon muscular contractures in *Die Deutsch Klinik,* Remark dismisses the subject by the statement that clonic and tonic spasms of the ileopsoas and rectus femoris without assignable cause, have been reported in neurasthenics by Klemperer, Koch and others.

The psoas parvus, according to the books, is an inconstant, rudimentary muscle, attached above to the last dorsal and first lumbar vertebræ, and below to the ileo-pectineal line of the pelvis. In these seven cases the muscle was represented by a band of fascia, extending along the inner borders of the psoas magnus, and receiving fibrous bands from each of the neighboring vertebræ. The function of the muscle in the lower animals is to bend the pelvis on the spine, a motion almost lost in man. It is not surprising that this muscle, which is undergoing retrograde evolution, should take on some pathological condition, and the excessive pain from its contracture may be accounted for by the fact that the attachments are to relatively fixed structures, so that the tension cannot be relieved by flexion of the parts.

An analysis of the cases shows that pain, tenderness and apparent tumor were present in all cases. The pain came on suddenly in two, gradually in five; it was limited to the side of the abdomen in five, and was referred to the leg in two. Four with extreme tenderness showed rigidity of the abdominal muscles on the right side, but this was probably a voluntary act. Fever was not present in any case, and the digestive disturbances seen in two of the patients were probably coincidents and had no relation to the trouble. One of the patients was markedly neurasthenic, the other six were not.

The differential diagnosis from appendicitis is difficult or impossible in cases of short duration, with the four classic symptoms of appendicitis present.

Long-continued severe pain in the right iliac fossa with a marked tumor, but without fever and without digestive disturbances, would indicate trouble other than appendicitis. However, it is not essential that the diagnosis should be made before operation, provided the condition is recognized, if present, as soon as the abdomen is opened. The presence of a tense tendon along the edge of the psoas magnus renders diagnosis easy through an exploratory incision.

The treatment consists in cutting of the tendon and all tense bands, which may be done either transperitoneally or retroperitoneally, preferably the latter, since by working retroperitoneally the peritoneum serves as a retractor in keeping the intestines out of the way. The glistening tendinous fascia may be picked up with a clamp and cut, also all tense bands of accessory tendons. The common iliac artery is well out of the way inside of the tendon, and the nerves are beneath the large muscle, and to the outer side, so no important structures are liable to be injured.

The results of the operation have been entirely satisfactory thus far, the relief being immediate and lasting.

THE REDUCTION OF THE FRAGMENTS PRELIMINARY TO INTERNAL SPLINTAGE IN CASES OF FRACTURE OF THE LONG BONES.

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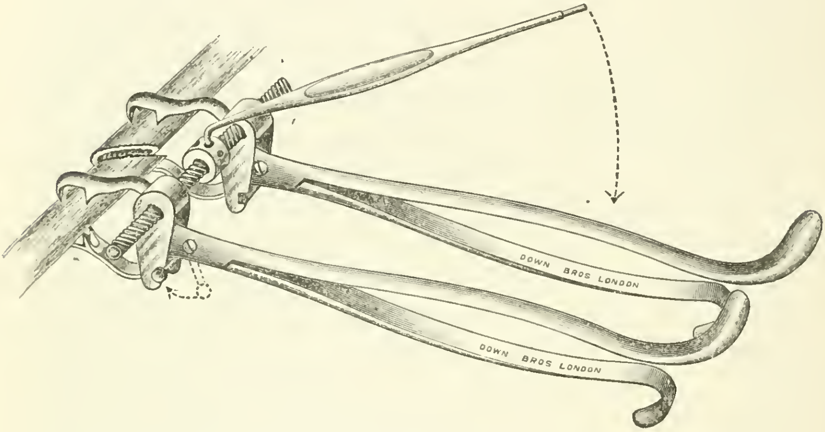
In Annals of Surgery, November, 1912, p. 769, Gerster publishes an interesting article on "The Reduction of the Fragments in Fractures of the Long Bones." The need for some mechanical device to effect reduction has long been felt. During the operation great difficulty is often experienced in reducing and maintaining the fragments in correct alignment while a Lane's plate is applied and this is particularly the case in fractures near the middle of the shaft of the femur of some weeks or months duration, so much so that occasionally after repeated attempts at reduction have failed it is necessary to remove portions of the ends of the bone in order to obtain correct apposition. Although much can be done by extension applied immediately in recent cases and particularly by employing Jones' method with a Thomas' knee splint, there still remain a certain number of cases in which the result is bad. The requisite care in nursing may not always be attainable and in outlying districts medical aid may not be so easily procured as in towns. Such cases come to operation. During the operation much of the force used in producing extension is applied through the knee-joint and sometimes synovitis is set up. The procedure is the reverse of elegant and is excessively tiring to the assistants. When operation is performed in the house occupied by the patient there may be difficulty in finding supports for any pulley extension such as the operator is accustomed to use in his own theatre. These considerations led me in October, 1911, to devise an apparatus that would help to render reduction easy. It was clear that the method should involve applying the force of separation as a direct interaction between the fragments themselves. In principle the apparatus was similar to Gerster's turnbuckle. At first it was arranged that one end of the extension screw should pass through a hole bored centrally through the joint of one of the bone-holding forceps, while the other end passed either through a similar hole in the other, or in front of or behind this hole according to the relative positions of the fragments; but it was found that this arrangement, though readily causing the separation of the fragments, failed in affording easy alignment and coaptation. I am much indebted to Mr. H. W. M. Gray for having tried the instrument at this stage in one of his cases on Jan. 24, 1912. This instrument was also shown at the meeting of the British Medical Association, held at Liverpool in 1912. The instrument was then modified in such a way that the sliding piece on one end presented a slot in which the bone-holding forceps could slide, but again the comparative fixity of the other end rendered adjustment both of the fragments and of the instrument difficult, because the forces in operation are considerable. The instrument was again modified so that a slot was formed in each end piece and each was provided with a hasp so that the bone-holding forceps could be shut into the slot without the risk of its coming out during the progress of extension. This instrument (Fig. 1) is applied in a similar manner to Gerster's, that is to say, extension is carried out as far as possible by ordinary means without using undue force and the fragments are seized with Lane's bone-holding forceps applied parallel to each other and as near together as possible. The pieces on the screw are then adjusted equally from the middle to fit the distance between the forceps and the instrument is lowered over the forceps so that the slots engage them and the hasps are closed up. The handles of the forceps are held one in each hand by an assistant and the screw is turned by the operator until the full extension has been produced. Coaptation being thus secured is maintained, if necessary, by using a third bone-holding forceps to grasp the fragments. At this stage it may or may not be convenient to remove the extending instrument according to the case. The plating is now proceeded with. The instrument affords the following advantages:

First, it is applicable to all the ordinary bone-holding forceps of the Lane type in general use, so that no additional or special forceps need be provided. By using a Lane forceps much room is gained in the wound for manipulation of the plate because the bows of the Lane forceps afford ample room for inserting the plate and screws while the forceps are still in position. The great desideratum in these operations is more room in which to work without increasing the size of the wound.

Fig. 1.



Secondly, it is not necessary to interrupt the process of extension and change the apparatus. The length of screw provided is sufficient for all ordinary cases in which the fragments have been separated as far as possible before the forceps are applied. In many cases the instrument will not be required, such as recent cases in which extension has been employed from the first. Such cases are treated by open operation because of the difficulty of securing proper attention when external splints and extension are used. At operation complete reduction is easily obtained, but occasionally it may be helpful to have the instrument at hand. In cases in which an additional fragment or splinter is present there will be comparatively little difficulty if the case is recent and anæsthesia profound, but if the condition is of old standing the difficulty may be very great indeed and the instrument will be required. It is clear that there is a call for an instrument of this kind because two surgeons have independently designed one, and since both have employed the same principle in its construction it is probable that this principle is the best. At the present time it seems to me to be open to question whether further refinements are necessary or advisable. It is possible to add a ratchet wheel to the middle of the screw bar and to apply over it a boxed ratchet spanner which greatly hastens the process of reduction. But the more simple thing seems to me to be the best, until such time as it is shown to be inefficient by reason of the extension occupying too much time. It is also open to question whether such extension is not safer when it is performed slowly so that the tissues may be stretched and not ruptured. The method is simple, gentle, and entirely efficient.

FRACTURES THROUGH THE TROCHANTERS OF THE FEMUR.*

BY ASTLEY PASTON COOPER ASHHURST, M.D.,
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Sir Astley Cooper was the first to classify intelligently the typical fractures of the upper end of the femur. He distinguished three species:

" First, that in which the fracture happens through the neck of the bone entirely within the capsular ligament (Fig. 1).

" Secondly, a fracture through the neck of the thigh-bone at its junction with the trochanter major; which is external to the capsular ligament (Fig. 2).

" Thirdly, when the bone is broken through the trochanter major, beyond its junction with the cervix femoris" (Fig. 3).

He further states, in speaking of the second variety, " It frequently happens in this injury that the fracture of the neck of the thigh-bone is complicated with an injury of the trochanter major and trochanter minor." In other words, he recognized the fact that fracture of the neck *at its junction with the trochanter major is only an uncomplicated form of fracture through the trochanters;* or, to put it a little differently, that *fractures through the trochanters usually are comminuted* and often are combined with fracture of the neck at its base. The three illustrations here reproduced, sketched from Cooper's plates, show what he regarded as typical fracture lines.

From Cooper to Amesbury, Lonsdale, and Malgaigne; from Malgaigne to Hamilton; and from Hamilton to Stimson and Cotton, the description of these fractures became more complex, and their interpretation more difficult and their classification less lucid. Nothing of importance was added to Sir Astley's description, and though subclasses were formed this served only to render the comprehension of the subject more difficult for the student.

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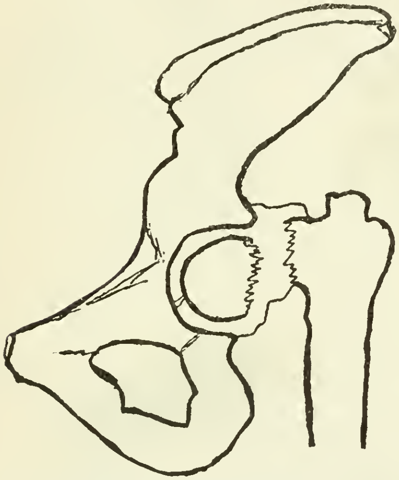
* Read before the Philadelphia Academy of Surgery, April 7, 1913.

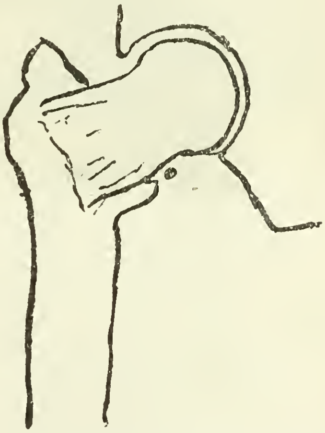
Amesbury, under the general heading, "Fracture of the Trochanter Major," says: "Occasionally, fractures of the trochanter major pass through the femur, so as to divide the neck of the bone and the trochanter from the shaft, these two parts remaining naturally connected. In these cases, the fracture is situated between the trochanter minor and the lower part of the root of the neck, sometimes taking one direction, and sometimes another." He quotes a case from Guthrie (*Med.-Chir. Trans.*, vol. xiii) in which autopsy showed, as the result of a heavy fall on the hip, a fracture external to the capsule; the little trochanter was broken off and with it the attachment of the psoas and iliacus. The head and neck were separated from the shaft by a diagonal fracture, extending from the upper and outer part of the trochanter major to the trochanter minor, so as to leave the insertions of the pyriformis, gemellus, obturator externus and internus, and quadratus, with the head and neck. He also quotes a case of Syme (*Edinb. Med. and Surg. Jour.*, vol. xxv) in which post-mortem examination showed the capsular ligament entire, but two fractures beyond—one detaching the neck where beginning to spring from the shaft, the other running obliquely downward and inward through the trochanters, so as to detach the posterior part of the greater and the whole of the lesser trochanter in one piece from the body of the bone.

FIG. 1.



Fracture through the neck, entirely within the capsular ligament (Cooper).

FIG. 2.

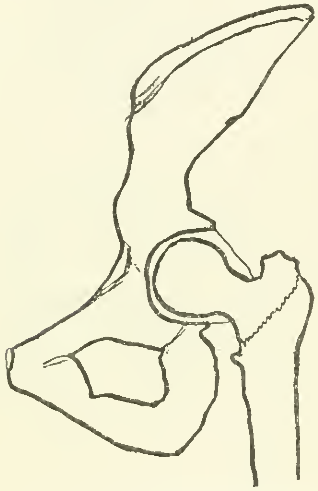


Fracture through the neck of the thigh bone at its junction with the trochanter major (Cooper).

Lonsdale describes fractures of the great trochanter thus: "The direction the fracture takes varies very much; it most frequently, however, extends so as to include a portion of the neck of the bone and of the trochanter minor, at the same time splitting the two trochanters from one another, and allowing of the neck of the bone being wedged in between the two; in which position it is often so firmly fixed that it is impossible to make extension sufficient to unlock the portions of bone from one another. The wood cut represents the kind of fracture." (Fig. 4.)

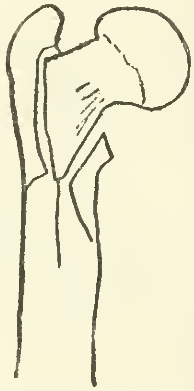
Malgaigne, with his fondness for refinements in classification, speaks thus of extra-capsular fractures:

Fig. 3.



Fracture through the trochanter major (Cooper).

Fig. 4.



Fracture through the great trochanter (Lonsdale).

"The *type* is at the base of the neck; but two sufficiently rare varieties are when the fracture is (1) just internal to the typical site (partly intra- and partly extracapsular); (2) just external or below. This second variation from the type is much the more important—the result is that the fracture essentially divides the great trochanter, which becomes part of the upper fragment. *But it is excessively rare* for such a fracture to be single; the multiple (*i.e.*, comminuted) fractures are *incomparably more common*. And of these comminuted fractures there are two main types: (1) The great trochanter is fractured as well as the neck, and constitutes a *third fragment* (the more common type); (2) the lesser trochanter is fractured also (as well as the great trochanter and neck) and forms a *fourth fragment*." Other rarer types, he adds, are (1) Where the third fragment is formed by the lesser trochanter alone, the greater trochanter being part of the upper fragment; (2) where the great and lesser trochanters are united in the same fragment; (3) those where the greater trochanter alone is comminuted. He writes (p. 714), when speaking of sub-trochanteric fractures, "when the fracture is very close to the lesser trochanter, it is often enough comminuted and combined with an extracapsular fracture"; but his classification, while more elaborate, is much less easily comprehended than that of Sir Astley.

Hamilton made the explicit statement, when describing extracapsular fractures, that "almost invariably the acetabular penetrates the trochanteric fragment in such a manner as to split the latter into two or more pieces."

Cotton is rather diffuse when writing of "Fractures Through the Trochanters." He adopts a pathogenetical classification, dividing them into fractures by *direct violence* and those by *torsion of the leg.* "The lesions in the torsion fractures often show a combination of a torsion fracture (with spiral lines) through the trochanters, combined with a fracture between the neck of the femur and the intertrochanteric line. Breaks *directly* across," he adds, "between the level of the greater and lesser trochanters are rare; they are from direct violence usually. Such lesion may accompany a break at the base of the neck, perhaps from splitting of the trochanteric neck by this basal fragment." Torsion fractures, he says, may break the bone above or below the lesser trochanter; but these fractures clinically belong with those wholly below the trochanters. Speaking in a footnote of fractures below the trochanters, Cotton adds (p. 480), "Many fractures do not anatomically fall either in this class or in class 5" (fractures through the trochanters). He says (p. 488) fractures of the lesser trochanter often occur as a complication of spiral or splintering fractures.

Stimson prefers the terms "fracture through the neck" and "fracture at the base of the neck" to describe the "intracapsular" and "extracapsular" fractures; for the former he also uses Kocher's term "fractura subcapitalis," but thinks the term "fractura intertrochanterica" is not acceptable for the latter. For Kocher's term "fractura per-trochanterica" Stimson uses the term "fracture through the great trochanter and neck." Of fracture at the base of the neck Stimson writes (p. 360): "The line of fracture follows ordinarily the junction of the neck and shaft quite closely—that is, it coincides with the spiral line in front and the intertrochanteric line behind as they pass between the great and lesser trochanters. It may extend downward and detach the lesser trochanter from the shaft, leaving it attached to the neck, or go even lower and separate a part of the shaft. . . . In the majority of cases other lines of fracture traverse one or both trochanters, splitting off one or two pieces, usually from the posterior surface of the great trochanter, or comminuting it completely."

In discussing fractures through the great trochanter and neck (*fractura per-trochanterica* of Kocher), Stimson says it is an uncommon injury, and that few specimens are known; he has seen only one case himself, and there the fracture was *atypical.* In typical cases, he says, the "upper fragment is formed by the head, neck, and upper part of the great trochanter." He thinks the mechanism probably is forcible extension or abduction, with avulsion of the shaft from the upper fragment which is held by the Y-ligament. (This is what Ross would call a "sprain-fracture," because the fragment is torn off by ligamentous action.)

Stimson says there are 12 cases on record of *isolated fracture of the lesser trochanter;* as 9 of these have been reported since 1908, and were recognized by skiagraphy, it is probably more common than formerly thought.

Now it may be asked by the unprejudiced observer (and such usually is the medical student), " What is the use, and where the sense, in describing as *typical* a type of fracture *through the trochanters* which is *extremely rare,* and most cases of which are ' atypical '; while we regard as *atypical* a form of fracture which is quite common? "

My object in preparing this note on *fractures through the trochanters of the femur* is to call attention to this very fact; that the fracture usually considered typical is so rare that it should be considered atypical; while the " atypical " fractures, so-called, are comparatively very frequent.

Some years ago I had occasion to make a collection of skiagraphs of " typical fractures." My search through the many thousands of negatives stored at the Episcopal Hospital enabled me to find at last one skiagraph which corresponded to what is described in modern text-books as a *typical fracture through the trochanters.* I reproduce that skiagraph here as Fig. 9. I was struck with the great infrequency of the type, and began to keep my eyes open for other examples of fractures through the trochanters of the femur. Last autumn one of our resident physicians at the Episcopal Hospital asked me whether fractures of the lesser trochanter of the femur were not excessively rare. I replied that isolated fractures of the lesser trochanter might be, as I did not recall having seen any; but that at the time we were speaking there were in Dr. Frazier's wards in the Episcopal Hospital no less than four fractures through the trochanters of the femur, involving separation of the lesser trochanter. And inasmuch as it did not seem that the frequency of this injury was generally recognized, I thought it might be worth while to bring the subject before you to-night. I include in the series of cases two patients from Dr. H. C. Deaver's service at the Episcopal Hospital. Thus there are *six cases of fractures through the trochanters of the femur* in one hospital in a period of six months. This fact alone is testimony to the frequency of this " atypical " type.

The only surgeon since the times of Cooper and of Lonsdale who seems to have had a just appreciation of these fractures through the trochanters is V. Zachary Cope. He has recently written a most valuable article on "Impacted Fractures Through and Near the Femoral Neck." He insists on the frequency of impacted fracture of the neck at the head, from violence directly applied over the great trochanter; and on the frequency of impacted fracture through the base of the neck and the trochanteric region, which, as he says, "includes all those which used to be loosely called 'extracapsular fractures of the neck.'" He says: "The cancellous tissue of the great trochanter is split up by a firm wedge of bony tissue belonging to the cervix femoris. This wedging of the cervix into the trochanter region is responsible for two or three secondary fractures which frequently complicate the primary breakage."

Cope describes three grades of injury:

(1) A primary fracture occurs at the junction of the head and neck, and the base of the neck is then thrust into the cancellous tissue of the great trochanter, with secondary but incomplete fracture through the great trochanter.

(2) The firm tissue of the neck causes separation of the fragments of the trochanter along the lines previously mentioned. The tip of the great trochanter nearly always is drawn inward toward the upper rim of the acetabulum. This grade of injury he considers to be the most common type of fracture resulting from a fall on the hip.

(3) A further stage, when the small trochanter and a slice of the shaft are also split off.

He concludes that fracture of the base of the neck is always primarily impacted; and if the force applied is great, there are always secondary fractures, both vertical and horizontal, through the trochanteric region.

The conclusion of the whole matter, as it seems to me, brings us back to the classification of fractures of the upper end of the femur originally formulated by that greatest of teachers of surgery, Sir Astley Cooper. His facilities for observing the actual lines of fracture were confined to the post-mortem table; and zealously did he employ his opportunities. Our facilities, thanks to skiagraphy, are unlimited. But all that we have since learned merely confirms the justness and accuracy of his original observations. The typical fractures of the upper end of the femur are:

1. Fractures through the neck (Sir Astley's own term,

adopted by Stimson, the highest contemporary authority on fractures). Fig. 5 is typical; not impacted.

2. Fractures where the neck joins the trochanter, or at the base of the neck. Fig. 6 is typical; impacted. This skiagraph also shows an impacted fracture of the neck at the head, emphasized as frequent by Zachary Cope. The impaction of the neck into the trochanter connotes an incomplete fracture of the trochanter.

3. Fractures through the trochanters, which, as taught by Cooper, are typically comminuted and combined with fracture of the neck at its base.

(*a*) The *uncomplicated form,* as taught by Cooper, or the *first grade of injury,* as described by Cope, is represented by impacted fracture at the base of the neck, already enumerated (Figs. 6, 8, and 9).

(*b*) A more advanced grade is represented by partial comminution of the great trochanter (Fig. 9).

(*c*) The most advanced grade, and what may be regarded as the typical fracture through the trochanters, involves injury of both trochanters, usually with some comminution (Figs. 10, 11, 12, 13, 14, and 15). Figs. 16 and 17 may also be added, though verging on the next type (subtrochanteric).

4. Fractures below the trochanters. Typical of the transverse type is Fig. 7. The oblique type verges into that last described (Figs. 16 and 17).

CASES OF TYPICAL FRACTURES OF THE UPPER END OF THE FEMUR.

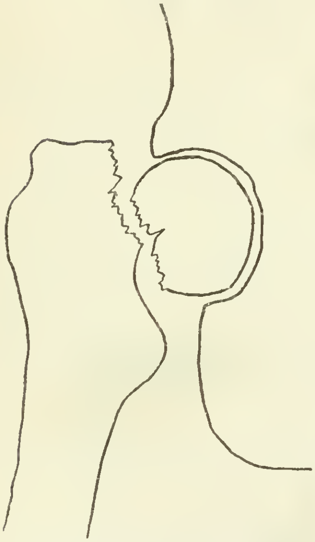
CASE I.—"*Intracapsular*" *Fracture of the Neck* (Fig. 5).—Mrs. Ellen G. was a woman aged forty-five years. Her neighbors accused her of being a drinking woman, and of having suffered at times from delirium tremens. One night she imagined she was being pursued, and jumped out of the second story window of her home. Apparently nobody paid much attention to her, as she returned to her room, seemingly unhurt. Later during the same night she jumped a second time out of the second story window, and was so unfortunate this time as to injure her right hip. She was brought to the Episcopal Hospital, and admitted to Dr. Frazier's service, January 3, 1913.

The right lower extremity was markedly everted, and was 2 cm. shorter than the left. There was a fracture of the neck of the right femur. Both knees were contused, and the left wrist was contused.

For the first week after admission she suffered from delirium tremens, at times verging on *mania a potu.* Then there was an interval of two weeks of calm. Then, on January 25, she developed acute cholecystitis; this subsided in three or four days under palliative treatment.

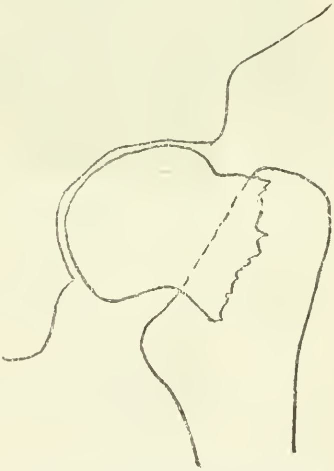
The fracture was treated by longitudinal traction, by Buck's extension apparatus, with lateral traction to the upper portion of the thigh. Owing to her delirious state this could not be very efficient at first.

Fig. 5.



Case I.—Fracture of neck of femur near head (typical) (January 13, 1913).

Fig. 6.



Case II.—Impacted fracture at base of neck of femur (January 27, 1913). Impacted fracture of neck at head present, but not shown in this tracing.

February 24. Out of bed.

March 11. Walks all around ward, with very little support from crutches. Shortening 1.75 cm. Flexion of hip to 100 degrees and abduction possible for about 15 or 20 degrees.

Case II.—*"Extracapsular" Fracture of the Neck, Impacted* (Fig. 6).—Jo M., thirty-eight years of age, was a Polish man, who did not talk any English. He came to Philadelphia from Brooklyn, looking for work, and while engaged in this occupation slipped and fell down a few steps. He says he doesn't remember what made him slip, or how he landed. He was brought at once to the Episcopal Hospital, and was admitted, January 26, 1913, to Dr. Frazier's service. The left lower extremity was more everted than the right, and he was unable to flex his thigh on the pelvis. There was 1 cm. shortening; the great trochanter was just above Nélaton's line. There were also fractures of the left radius (impacted Colles's), and of the mandible (compound).

Buck's extension was applied, with very little weight, as the skiagraph showed an impacted fracture at the base of the femoral neck, and it was not desired to disturb this.

March 8. Extension removed.

March 11. Shortening 1.5 cm. Flexion possible to 140 degrees (about); no abduction possible; limb in the longitudinal axis of the body, and in slight permanent external rotation.

CASE III.—*Fracture Below the Trochanters of the Femur* (Fig. 7).—John M. G. was thirty-nine years old. On October 12, 1912, he was at work in a house which was being torn down. He was stooping forward and engaged in tearing loose one of the floor boards when he heard a click in his thigh and then fell down and found he was unable to rise again. He was brought to the Episcopal Hospital and admitted to the service of Dr. Frazier.

There was complete loss of function of the right lower limb; it was rotated outward, there was 2.5 cm. shortening, but the great trochanter was not displaced upward. Inward rotation was not possible.

The limb was put on an inclined plane, between sand-bags, in slight abduction, and with weight extension (in longitudinal axis) of 15 pounds. Some union was apparent at the end of a week. On October 31 a new Buck's extension apparatus was applied.

November 25. Walking about ward on crutches.

November 27. Discharged.

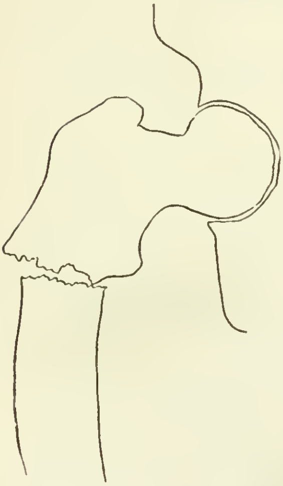
March 17, 1913. Returned for examination, 5 months after injury. The patient walks without noticeable limp, and complains of no disability. The shortening is 2 cm. There is flexion of the hip to 70° (20° beyond a right angle with the trunk); rotation and abduction are normal.

This patient had complained of pain in his femur for three weeks before it broke; and for two days previously, he says, he had a sense of false motion at the point where the fracture subsequently occurred. Examination revealed no constitutional cause predisposing to fracture; but the appearance of the femur in the skiagraph is not normal.

TYPICAL (?) FRACTURES THROUGH THE TROCHANTERS OF THE FEMUR.

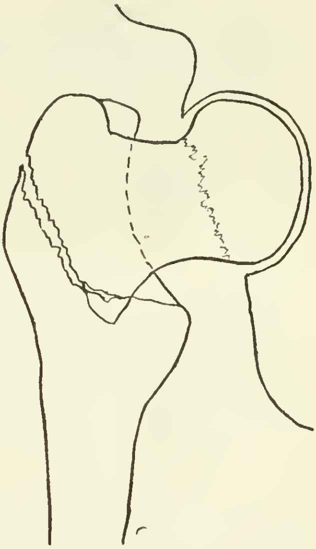
Case IV.—*Fracture Through the Trochanters of the Femur* (*Incomplete*) (Fig. 8).—Rachel B. was fifty-five years old. Walking along the street one day, she had the misfortune to step on a banana peel. She fell and hurt her right hip. She was helped home, and lay there incapacitated for a week. Then she was brought to the Episcopal Hospital and admitted August 9, 1910, to the service of Dr. H. C. Deaver. There was eversion of the lower extremity, and slight shortening.

Fig. 7.



Case III.—Fracture of femur below trochanters (typical) (October 12, 1912).

Fig. 8.



Case IV.—Fracture through trochanters of femur (impacted). Impacted fracture of neck at head (August 10, 1910).

Buck's extension apparatus was applied, with sand-bags for lateral support.

September 6. Up in chair.

September 25. Walking around ward all day.

October 8. Discharged.

CASE V.—*Fracture Through the Trochanters of the Femur* (*Complete*) (Fig. 9).—Thos. A., sixty-five years old, slipped on the icy pavement February 21, 1903. He was brought to the Episcopal Hospital and admitted to the service of Dr. G. G. Davis. There was pain, swelling and crepitus in the region of the great trochanter of the left femur. There was marked eversion of the entire lower extremity. Shortening was not noted.

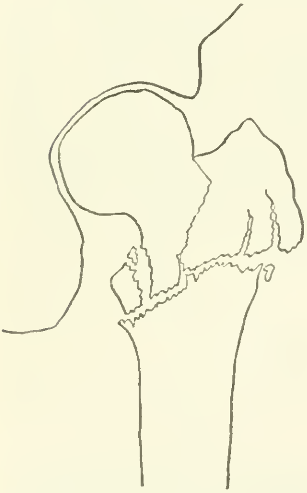
Buck's extension was applied, with a sliding splint to prevent rotation of the lower extremity.

April 7. Weights removed.

April 14. In chair.

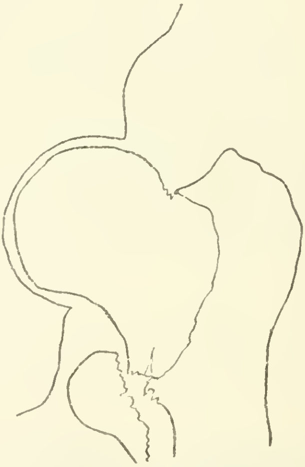
April 23. Discharged, walking on crutches.

FIG. 9.



Case V.—Fracture through trochanters of femur. Impacted fracture of neck at base (February 24, 1903).

FIG. 10.



Case VI.—Fracture at base of neck of femur (impacted): with separation of lesser trochanter (August 9, 1912).

FRACTURES INVOLVING THE LESSER TROCHANTER OF THE FEMUR.

CASE VI.—*Fracture of the Lesser Trochanter and Impacted Fracture of the Neck at its Base* (Fig. 10).—James O'R., forty-eight years old, was thrown off the running board of a trolley car ("summer car"). He landed on his left hip. He had severe pain, and was unable to rise. He was lifted from the street, placed on a chair, and removed to the Episcopal Hospital in a patrol wagon. He was admitted August 4, 1912, to the service of Dr. Frazier. There was great pain in the left hip; the limb was everted, and inversion gave excruciating pain. He was unable to invert his leg voluntarily. There was 2 cm. shortening, and the left trochanter was about 2 cm. higher than the right.

Buck's extension and sand-bags were applied.

August 8. Shortening was 2.5 cm. A Volkmann's sliding splint was applied to the foot, to prevent rotation, and outward lateral traction (6 lbs.) was applied to the upper portion of the thigh, with the longitudinal traction increased to 15 pounds weight. The patient was allowed to sit up in bed.

August 20. Lateral traction discontinued.

August 24. Weight on longitudinal traction gradually diminished.

August 28. All weights off. Every morning since first week thigh has been flexed and slightly rotated, while traction was maintained.

August 29. Massage ordered.

September 9. Shortening 1 cm. Active flexion of hip to 135°.

October 5. Discharged.

March 17, 1913. Returns for examination. There is a moderate limp, and patient complains of pain and stiffness in joint. He has done no work since his accident. But it should be noted that he has not yet secured an award of damages for his injury. There is 1 cm. shortening; flexion of the hip is possible to 75° (15° more than a right angle), abduction only to 8°, while rotation is normal.

Case VII.—*Fracture of the Lesser Trochanter, with Partial Fracture of the Neck at Base* (Fig. 11).—Amelia L., seventy-two years of age, tripped over the carpet as she walked across her room, and fell heavily, striking her left hip on the floor. She was unable to move, and was not moved until taken to the Episcopal Hospital in the ambulance. She was admitted September 12, 1912, to Dr. Deaver's service. On admission she was lying on her right side, with thighs flexed, and seemed comfortable in that position. When she was turned on her back, the left hip and knee were flexed, and the left lower extremity rotated outward. It could be rotated inward, but this caused moderate pain. When the limb was fully straightened it appeared to be shorter than the right.

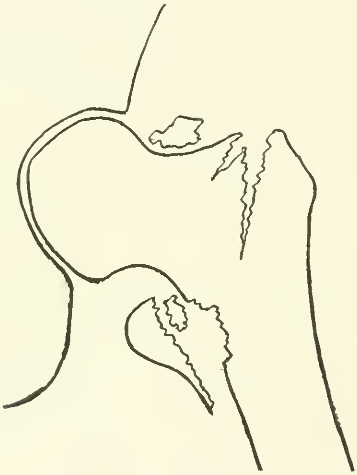
Buck's extension was applied, with longitudinal traction, and sand-bags.

September 26. Lateral outward traction was also applied. Patient has frequent asthmatic attacks.

October 13. Patient died suddenly (within five minutes), apparently from cerebral embolism.

Case VIII.—*Fracture of the Lesser Trochanter with Fracture Through the Trochanters* (Fig. 12).—Charles H. M., seventy-four years old, was struck by a falling scaffolding, which he thinks caught him in the back, throwing him on his face. He was picked out of the wreckage in an unconscious condition, and brought to the Episcopal Hospital, where he was admitted, December 1, 1912, to the service of Dr. Deaver.

Fig. 11.



Case VII.—Fracture of femur through trochanters, with separation of lesser trochanter (September 23, 1912).

On admission he was conscious, but badly shocked. Vomited several times after admission. There were swelling and spasm of the muscles of the left thigh; the limb was in external rotation; 1 cm. shortening was present; slight crepitation around the hip-joint, with preternatural mobility.

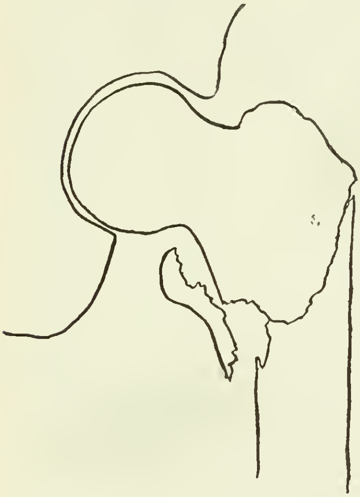
Limb placed between sand-bags and Buck's extension applied. Sand-bag also over thigh to control spasm of muscles.

Patient has used catheter twice daily for four years on account of prostatic obstruction.

December 12. Patient was removed to his home. Subsequent history not known.

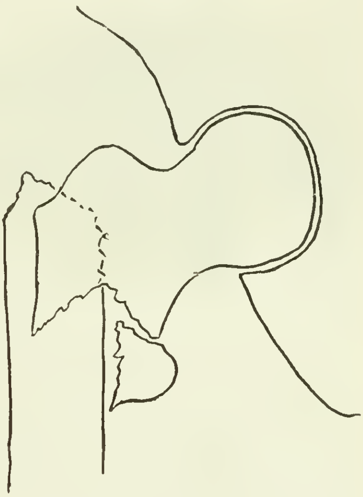
Case IX.—*Fracture of the Lesser Trochanter and Fracture Through the Trochanters* (Fig. 13).—Mary D. was forty-six years old. She was crossing the street with the week's wash in her arms, when her foot struck a brick in the pavement. She fell, striking her right hip against the curb-stone. She had just had "two glasses" of beer, but nevertheless she fainted. On admission to the Episcopal Hospital, Dr. Frazier's service, January 9, 1913, the beer had begun to do its work, as she was slightly intoxicated. The right lower extremity was everted, and inversion or any other motion caused pain. There was fulness in the upper third of the thigh, with ecchymosis laterally just below the loin. There was 2 cm. shortening, and the great trochanter was higher than that on the left. (According to the X-ray the fracture is below the great trochanter, so the upper end of the shaft must have been mistaken for the great trochanter.)

Fig. 12.



Case VIII.—Fracture of femur through trochanters, with separation of lesser trochanter (December 3, 1912).

Fig. 13.



Case IX.—Fracture of femur through trochanters, with separation of lesser trochanter (January 10, 1913).

Buck's extension and sand-bags were applied, with the thigh in abduction.

From January 10 to 15 the patient was on the verge of delirium tremens.

January 16. Mental state much improved.

February 24. Shortening only 1 cm.

March 12. Walking well with crutches.

June, 1913. Walks with only moderate limp and very little disability. Has been home 3 months.

Case X.—*Fracture of the Lesser Trochanter with Fracture Through the Trochanters* (Fig. 14).—John S., fifty-nine years old, fell from a ladder, a distance of about 9 feet, striking on his right hip. He was unable to rise without help, and has been unable to move his right leg since the accident. He was brought by patrol wagon at once to the Episcopal Hospital, and was admitted, January 18, 1913, to Dr. Frazier's service. The right lower extremity was in outward rotation, and the patient was unable to rotate it inward. There was 2.5 cm. shortening. Swelling and tenderness around the hip were marked, and there were crepitus and deformity of the upper end of the femur.

Buck's extension was applied.

January 19. The limb was placed in flexed position on an inclined plane. Skiagraph in this position showed more deformity.

January 22. Patient was etherized, and Dr. Ashhurst applied a plaster-of-Paris casing, with the limb in full abduction. Skiagraph through case showed some improvement in position.

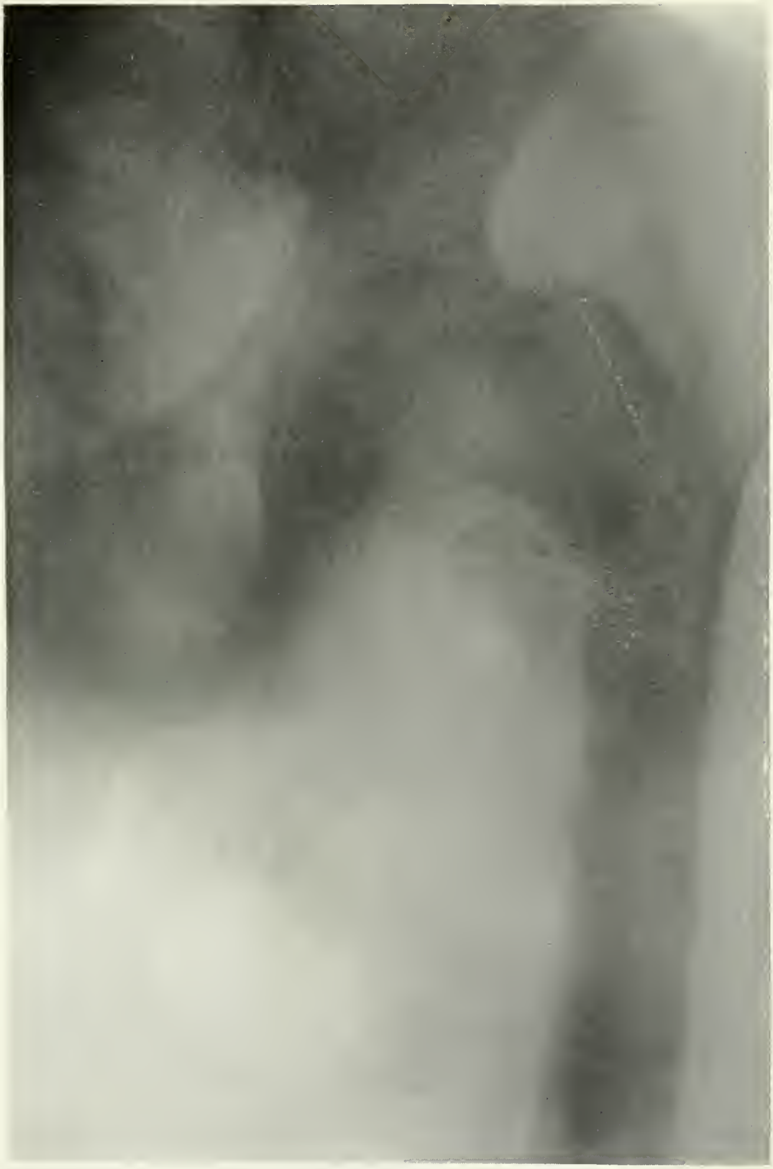
March 5. Plaster case removed, after being on for six weeks. Good union. Shortening 3 cm. (Fig. 15). Flexion to 110°, abduction to 20°, good rotation.

Case XI.—*Fracture of Lesser Trochanter, with Comminuted Fracture Below Trochanters, and Splitting Fracture Through Greater Trochanter* (Fig. 16). John S., thirty-four years old was a bridge-worker. On the morning of August 13, 1912, at 8 o'clock, while at work on a bridge, he lost his balance and fell 30 feet to the ground. As he landed he struck his right thigh upon a beam. He had very severe pain and was unable to rise. He was carried into a neighboring house, and was brought thence by the ambulance, being admitted to the Episcopal Hospital, in Dr. Frazier's service, at 8.30 A.M. There was no shock. Above the middle of the right femur there was deformity, crepitus and preternatural mobility. Fracture of femur, seemingly oblique, with some overlapping of fragments. The limb was in outward rotation. The shortening was 4 cm.

Buck's extension was applied, with Volkmann's sliding footpiece to prevent rotation of the limb; 15 pounds weight.

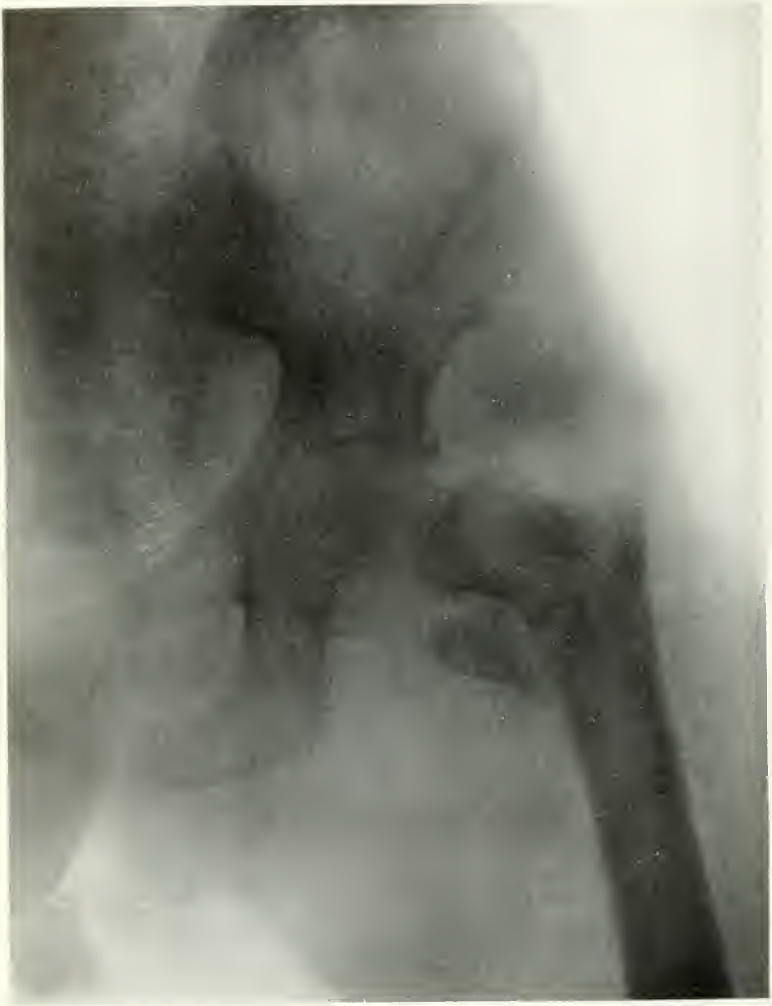
August 14. Entire thigh is extremely swollen; skin is tense and marked tenderness is present. Ice locally.

Fig. 14.



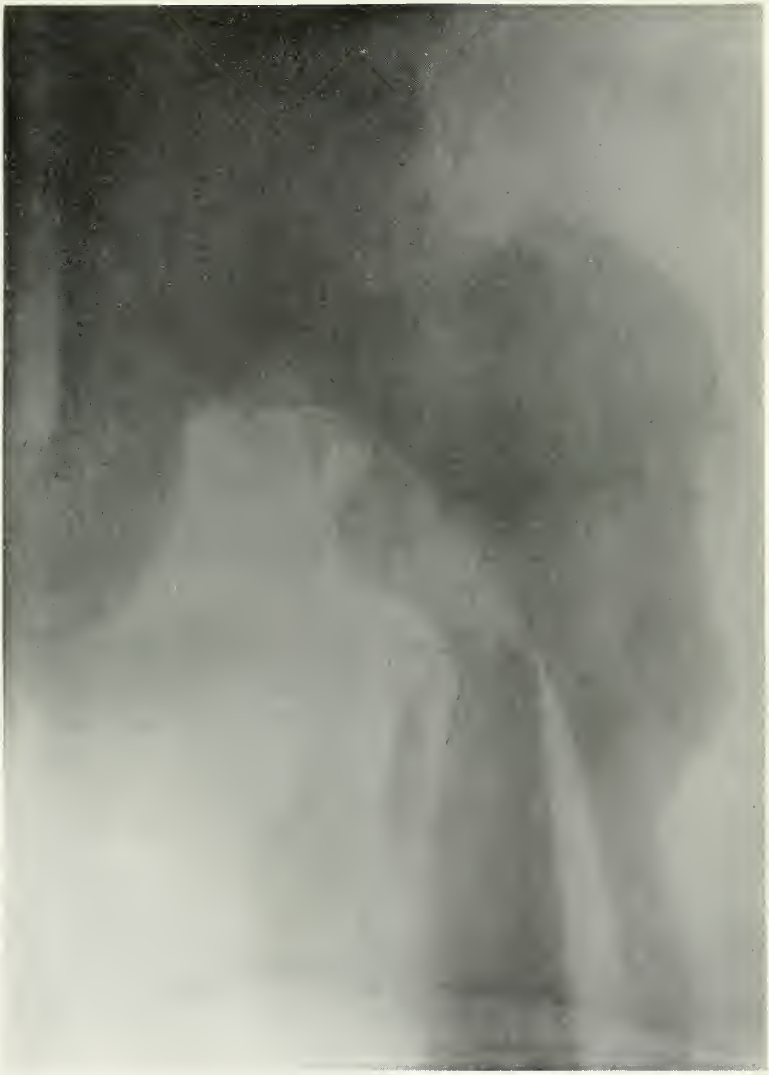
Case X.—Fracture of lesser trochanter with fracture through the trochanters (January 18, 1913).

Fig. 15.



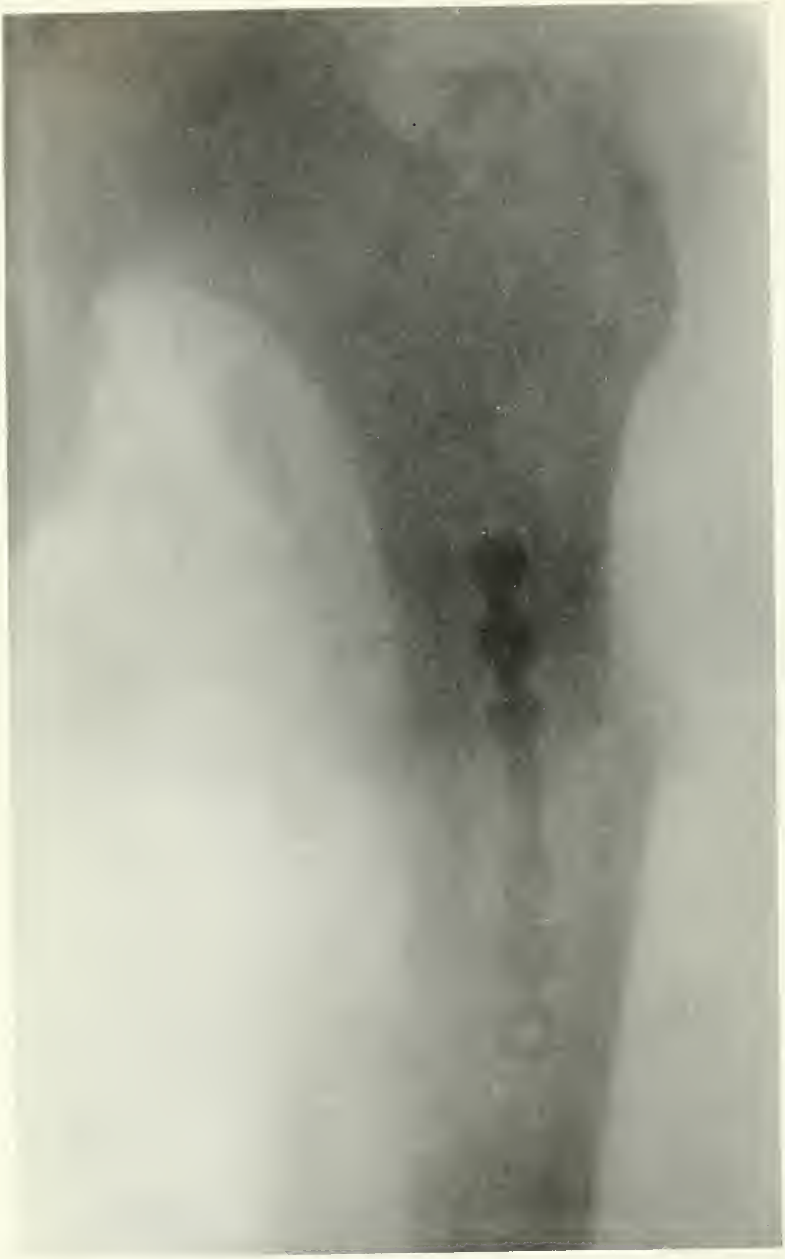
Case X.—Two months after injury. Position obtained by forcible abduction under ether (March 12, 1913).

Fig. 16.



Case XI.—Fracture of lesser trochanter, with comminuted fracture below trochanters and splitting fracture through greater trochanter (August 13, 1912).

Fig. 17.



Case XII. - Two months after operation (October 12, 1912).

August 15. Six pounds added to extension (21 pounds in all). Ecchymoses over thigh. Abrasion noted over site of fracture, on outer side of thigh.

August 19. Shortening 2 cm. only.

August 21. Extensive ecchymosis; swelling much less; skin can be wrinkled.

August 26. Operation by Dr. Ashhurst. Lane's plate applied to seat of fracture, three screws in each fragment. The lowest screw twisted off after half had been screwed into bone. Limb dressed in plaster of Paris from toes to groin, with Buck's extension inside of case, from knee down. About 20 pounds of weight extension.

September 20. Plaster case removed. Incision healed. Active and passive motion begun. Good union. No shortening or deformity.

October 1. In chair.

October 20. Walking with crutches.

October 28. Can walk without crutches. No shortening. Discharged (Fig. 17).

March, 1913. Patient writes that he is working, and except for some stiffness of knee has perfect use of his limb.

June, 1913. Examination shows no shortening, and no deformity. Motion of hip-joint perfect, except slight limitation of internal rotation when thigh is flexed. Knee cannot be flexed beyond 110 degrees, motion apparently being checked by adhesions of muscles to the femur.

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SIMULTANEOUS FRACTURE OF BOTH PATELLÆ,*

WITH REPORT OF TWO CASES AND A REVIEW OF THE LITERATURE.

BY CARL ROSSOW STEINKE, M.D.,
OF PHILADELPHIA.

Simultaneous fracture of both patellæ is not a common occurrence, and consequently each man's personal experience with such is limited. Corner,[1] in a report of 504 cases of fractured patellæ, found only 1 per cent. bilateral, but does not state how many of these were simultaneous. Georg Müller[2] in reviewing 1000 fractures had 13 fractures of the patellæ, none of which were simultaneous. Heineck[3] collected 1100 cases of fractured patellæ, all treated by the open operative method over a period of ten years, with only 10 simultaneous cases. Chaput[4] in reporting a case of simultaneous fracture of both patellæ says, "The interest here is in the rarity of simultaneous fracture of the patellæ."

In a letter from Dr. William J. Mayo he says, "So far as I know, we have never had a case of simultaneous fracture of both patellæ."

Considering the rarity of this condition, I thought it would be of interest to collect the cases recorded in the literature. In every case the original report has been consulted, unless otherwise stated, so that the cases are authentic and the data correct.

The mode of fracture may be from direct violence, or indirect as by muscular contraction, or a combination of the two.

The type of fracture in simultaneous cases may be, as in fractures of a single patella, transverse, longitudinal, oblique, stellate, comminuted, compound, or any of these in combination, depending upon the manner and severity of the injury causing the same.

The injury occurs more frequently in men than in women.

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* Read before the Philadelphia Academy of Surgery, April 7, 1913.

According to Piersol,[5] "The bone is not fully formed until after puberty, perhaps, not before eighteen." Consequently such an injury is not likely to occur in the young. Nor would it be expected in the aged, for the reason that the fracture of one knee-cap is uncommon in elderly people.

The following cases were operated on by Dr. Charles H. Frazier, and I am indebted to him for allowing me to report the cases at this time.

Case I.—H. G., male, age thirty-six. Family and personal history negative. On November 18, 1912, in mounting his horse, the patient's foot slipped from the stirrup, and in attempting to regain the stirrup, both knees were thrown together and pushed violently against the horse. The horse kicked back in some peculiar manner, and, according to the patient's story, struck both knees with the one blow. He was unable to rise and fell to the ground with absolute loss of function of both legs. He was brought to the Episcopal Hospital the next day. Examination revealed a well developed and well nourished white male, with nothing in his general condition worthy of note, except perhaps, for patches of psoriasis about the elbows on the extensor surfaces, scattered areas on the back, legs, and over the forehead.

In examining the lower extremities the legs were found to be extended on the thighs as he lay in the dorsal position, and both patellæ showed transverse fractures with marked separation of the fragments. The fracture of the patellæ passed through about the junction of the upper with the lower third. Extreme tenderness was noted at the point of fracture and there was marked swelling about both knees. There was complete loss of function of the knee-joints. No marks of contusion from a kick were to be found, therefore the fractures were thought to be caused by muscular contraction.

Operation (November 22, 1912).—The fields of operation were shaved, scrubbed with green soap, sterile water and alcohol, and a dry fluff dressing applied the night before operation. The same process, omitting the shaving, was repeated the morning of operation. Just before the incisions were made official tincture of iodine was applied to the parts. A curved incision was made from the internal condyle of the femur upward to just above the upper border of the patella, and down to the external condyle of the right femur. The flap was dissected back to expose the fragments, and the joint opened; the blood clot, of which there was a moderate amount, was removed. The edges of the torn aponeurosis were found between the fragments. The end of the fragments were cleaned. A hole was drilled from the anterosuperior surface of the upper fragment, and from the anteroinferior surface of the lower fragment, the drill emerging at corresponding points on the posterior of each fractured surface. A No. 18 silver wire was run through the drilled holes, the synovial membrane and aponeurosis, with the capsule were then sutured with chromic catgut and the wire twisted to bring the fragments in apposition. The skin was sutured with interrupted silkworm gut. The same procedure was followed on the left leg, posterior splints applied, and the patient put to bed with the legs elevated.

There was an evening rise of temperature to 100.4° each day, and on November 28 slight swelling and redness were noted about the right knee. The joint was aspirated, withdrawing 20 c.c. of slightly turbid fluid, and the same amount of a 2 per cent. formalin in glycerine solution injected. No bacterial growth was obtained from the fluid removed. There was considerable pain in the knee for the remainder of the day. His temperature remained practically normal after two days. All swelling and redness disappeared, so that on December 8, plaster-of-Paris casts were applied. The patient was out of bed the tenth day and walked with the aid of crutches on the 23d. The casts were removed on December 31, and the patient was discharged on January 4, 1913, just six weeks after the operation.

In a letter from him dated March 25, 1913, about four months after the operation, he writes as follows: "I used the crutches only four days after leaving the hospital and carry a cane on the street merely as a precaution. I have no difficulty in stepping upon and down from curbs, but find it rather hard to go up an incline. However, on the level, I walk very naturally, and have the power to extend my legs from the bent position. It is not necessary for me to lie down and rest as I did at first, since my strength is increasing daily. Sitting on the edge of a table I can bend my right knee 90° and the left about 75°."

Case II.—R. C., male, white, age fifty-six. His past history is of the best and his habits are good. Family history negative as to the condition under consideration.

The patient, in descending the cellar steps in the dark, a lighted candle in one hand and a coal bucket in the other, slipped on the last step, threw himself backward to regain his equilibrium, felt something give way in each knee, at the same time experiencing acute pain in the same location, and both legs doubled up under him as he fell to the cellar floor. Transverse fracture of each patella was found. He was taken to the Germantown Hospital where he was operated upon five days later by the suture method, as follows:

Through a curved incision, the concavity upward, the fracture of the left patella was uncovered. The upper fragment was larger and represented three-quarters or more of the bone. The fringes of the capsule were inverted, and there were lateral tears for a distance of an inch or a little more on either side. The blood clot, which partially filled the joint, was removed and the surfaces of the broken bone laid bare and the wound in the synovial membrane and capsule closed with two layers of chromic catgut. The incision in the skin was closed with superficial silkworm gut sutures. On the right side, the conditions were practically the same as those on the left with the exception of the fact that the lower fragment was a little larger, possibly one-third of the entire bone. There were, however, the tears of the capsule on either side of the patella. The closure of the wound and the approximation of the bones was affected in the same manner as on the opposite side. Both wounds healed by first intention.

The splints were removed at the end of the first week, and the legs allowed to lie over a pillow in position of semi-flexion. Massage was begun on the tenth day, and passive motion on the seventeenth day, and the patient was allowed to walk at the end of the fourth week. Upon his discharge from the hospital, six weeks after operation, he was able to get around with crutches and could flex both legs almost to a right angle.

At present, about four months since the operation, he goes about the house without crutches, although a crutch is taken as a precaution when going to business. The legs now bend to 90 degrees and he has good extension power.

The following is a summary of the cases of simultaneous fracture of both patellæ found in the literature:

Back in 1817 Desault[6] writes of a case as follows: "A man in the Hotel Dieu fractured the rotula of each knee, in the operating room, by means of convulsive motions, produced by the operation of lithotomy." There are no other facts mentioned.

Sir Astley Cooper[7] writes of a case as follows: "A young woman was brought into my house in her father's arms and he said, 'I am obliged to carry her for she has lost the use of her legs, having broken her knee-pans eight months ago, and she has never been able to use her limbs since.' Passive motion was directed, and she was ordered to try and extend her legs after they had been bent by the surgeon. At first she could effect but little; however, by repeated trials she gradually recovered the use of her limbs."

In one of the Guy's Hospital Reports[8] the following case is recorded: A man suddenly thrown forward, in trying to save himself from a fall, heard his knees crack, and he fell to the ground. Four days later he was taken to the hospital, where the patellæ were strapped. Straight splints were applied and the legs elevated. Three days later the left patellar fragments were in apposition, while the right showed one inch separation.

Sir Astley Cooper saw him and the treatment pleased him. On the twelfth day the patient is reported as "going on perfectly well." No other notes were obtainable concerning this case.

Tufnell[9] tells of a woman, thirty-nine years old, who slipped in running down stairs, made a violent effort to catch herself, but fell forward striking her left knee on one of the steps. Examination showed the left patella to be fractured in a stellate manner and the right transversely, being torn across by muscular violence. She was treated by means of bandages and posterior splints. Passive motion was started after seven weeks and on the fifteenth week the patient left the hospital without the slightest tendency to lameness. Union was apparently osseous in the stellate fracture, while that of the transverse was by a ligamentous band.

R. Johnston[10] relates the case of a woman, thirty-three years old, who tripped, heard a crack and felt something give way. She fell and was unable to get up. Both knees were found to be swollen. Three days later the right was put up after the method devised by Dr. Sanborn,[11] and the left after Sir Astley Cooper's[12] method. Eighteen days later there was bony union in the right patella, but the left had a separation of one-quarter inch and ligamentous tissue between the fragments. Patient was discharged in about six weeks. No further notes were obtainable.

Godfrey[13] records the case of a man, who, in mistaking the lower step in coming down stairs, fractured both patellæ transversely. After many months he obtained free use of the knees and recovered without a limp.

Wendover[14] tells of a man slipping and bringing unusual strain on the left leg, with the resulting fracture of the patella. In bringing the right leg into play to save himself the right patella was broken. Both the fractures were transverse. No further mention is made as to the patient's recovery.

H. O. Marcy[15] writes of a woman, thirty-eight years old, who, in a misstep, while crossing from the curbstone to the street, made a violent muscular exertion in trying to save herself from a fall, felt something give way in both knees and she fell to the pavement. Both patellæ were found to be fractured transversely near their middle, the upper fragment lying two inches above the lower. Ligamentous union of about ¼ to ½ inch followed.

In a letter to Dr. Wight[16] from Dr. Marcy, the latter says concerning the above case: "She could walk fairly well on the level, taking pains to keep the lower limbs nearly straight. Bending the knees gave the fear and indeed, I believe, the sensation of falling. She had great difficulty in going up and down stairs." Dr. Wight also mentions another case reported by Dr. Marcy, of single fracture with short ligamentous union, who, some years later by muscular action, broke this ligament and also the other patella at the same instant. Dr. Marcy says: "She made a very imperfect recovery, with long ligamentous union. Oddly enough the refractured patella gave the best result in marked contrast to the other patella. She cannot cross from the road to the sidewalk without help, and walks by keeping the lower limbs stiff and swinging them, much as in a case of ankylosed knee." In a letter to the writer, March 18 of this year, concerning the above two cases, Dr. Marcy says: "I sincerely regret that I cannot furnish further details."

Wight, in the same article as quoted above, reports a man, forty-four years of age, with simultaneous transverse fracture of both patellæ from a fall upon the pavement 3½ years previous to his seeing him. At the time Dr. Wight saw him he was using crutches and wearing splints, allowing partial flexion of the knees. There was fibrous union in both, with one inch separation of the right patellar fragments, and three-quarters of an inch of the left. He could not bend the knees in sitting down nor in going up and down stairs because of the lack of flexion in the knee-joints. He could not walk without the splints.

Wight[17] in a later article reports two cases of simultaneous fracture of both patellæ treated by wiring. One was a man of forty-one years, who received the impact of two hand trucks, one on each knee, and in making strong muscular action at the same time, fractured both knee-pans transversely. He operated one month later, wiring both. Seven months after operation the patient had good functional result.

The second was a forty-year-old man who fell and struck both knees on the pavement. The right patella had been wired six years before for fracture, with good result. Four weeks after the accident he wired the left patella and rewired the right, the wire of the previous operation having broken. Six months later the patient showed full recovery. Wight advises waiting at least fourteen days after injury before operating.

F. H. Hamilton,[18] in a review of 127 cases of fractured patellæ, has only one case of simultaneous fracture of both. This was in a young man twenty-two years of age, who fell on the sidewalk, causing transverse fracture of both patellæ. Treated by means of inclined plane, adhesive, and rollers saturated with flour paste. Dressings were removed on the thirty-seventh day and not re-applied. Both patellæ were united by ligaments of about ½ inch.

Beauvias[19] writes of a man, thirty years old, who in playing leapfrog, was about to spring forward after striking the ground with his feet, when he heard a crackling sound and felt as though he had received a blow on the legs. He fell to the ground and was carried to the hospital, where a transverse fracture of each patella was found. The fragments were not separated more than two centimetres.

Desquin[20] writes of a man of twenty-eight years, who made a jump to a trapeze, missed, and fell to the floor. Transverse fracture of both rotulas with separation of the fragments about three to four centimetres. He was treated by pasteboard splints and bandages. After one month the fragments were united by one centimetre of fibrous callous. The legs were dressed in extension with starch bandages. During the third month all dressings were removed and passive motion begun with massage. Final result was good.

Moullin[21] knew of a man, who in the first stride of a race, was conscious of something giving way in the knee, and in an effort to save himself from a fall, the other patella also snapped.

T. A. Smith[22] records a man, forty-five years old, who slipped on the ice and felt the right knee-cap snap. He got to the elevated, and in taking a seat. the left one snapped, causing him to fall. Twelve days later the patellæ were wired. On the thirty-second day he walked about the ward without crutches or cane, and in five days more he had ninety degrees flexion of the right and seventy degrees of the left knee. On the thirty-ninth day the fragments of the left were separated one-half inch and these were re-wired two days later, finding the first wire had broken. No final result was given. From the history of this case it would seem the left patella must have been broken at the same time as the right. but did not give completely away until he started to sit down. For this reason it is classed with this series.

Chaput[23] relates a case of simultaneous fracture of both knee-pans in a woman thirty-five years old. The fragments were wired and the prepatellar periosteum sutured with catgut. Further reference of this case is made by Lafourcade,[24] in saying that massage of the muscles was begun on the tenth day and of the joint on the seventeenth day, as well as passive motion. Two months later she could walk without crutches. There was flexion to a right angle in both knees at six months.

Warbasse[25] tells of 2 cases in which both patellæ of each were operated upon by the suture method. the bones having been fractured transversely near their middle. Good results were obtained.

Scudder[26] reports a man of forty-four years, who fell from a second story window to the sidewalk. causing comminuted fracture of both knee-caps, the right being compound. At operation all the left patella was removed, as it was broken into many small pieces. The right had three fragments sutured together with silk and other small fragments were removed. Posterior and side splints were then put on for one week. Plaster-of-Paris casts applied for four weeks longer. Discharged after nine weeks on crutches. Sixteen months after operation there was firm union of the fragments in the right side and flexion to a right angle without pain. Left flexed to slightly beyond a right angle. Function was good in both and there was practically no disability.

Prichard[27] showed a patient in whom both patellæ had been wired for fracture, with very good result.

Colle[28] reports the case of a man who fell from a wall and fractured both patellæ. He was treated by compression, immobilization and massage, with bad result. Fragments were separated two centimetres.

Porter[29] tells of a woman who jumped from a carriage to the ground and sustained fracture of each patella by muscular contraction. Wiring was successfully done.

Peyton[30] saw a case with Bullitt where both knee-caps were transversely fractured while a woman was standing on the icy pavement. Both snapped without any warning, probably due to the action of the quadriceps femoris in an effort to keep her balance. Bullitt operated on the tenth day, suturing the torn fibrous coverings with chromicized catgut. A most satisfactory result followed.

William Maddren[31] reports a woman of twenty-eight years of age who, in going down some steps, fell forward on reaching the last step, as though from weakness of the knees, striking both knees upon the ground. She felt something crack in falling and experienced great pain and loss of function in the knees. Examination revealed swelling of both knee-joints and transverse fracture of each patella. Tight bandages and posterior "L" splints were applied. The fifth day she was taken to the hospital and the fragments drawn in apposition by suturing both the tendinous capsule and aponeurosis with chromic catgut. Plaster-of-Paris casts were applied. Casts removed in six weeks and passive motion begun. Posterior splints were worn a few weeks longer. Result was osseous union of the fragments, with restoration of function.

Mayer[32] tells of a woman of thirty-nine years falling on the left knee, was assisted up, and fell on the right, fracturing both patellæ. She was not operated on for six months and there was no attempt at union. The fragments of the right were separated five centimetres and the left seven centimetres. In operating, the surfaces were freshened, the patellæ looped, and in addition, the fragments were sutured by one wire. A very satisfactory result followed, with flexion of ninety degrees.

McArthur[33] writes of a patient fracturing one patella, treated by splint and massage, with a ligamentous union resulting. Some years later the patient fractured both patellæ simultaneously, but the manner of the fracture is not stated. The lower fragment in the knee which had been broken previously was attached to the lower tendon and was removed; the elongated ligament of union, being attached to the patella, was sutured to the patellar tendon insertion. This gave a good fibrous union and a useful joint. The other patella was wired with silver, resulting in bony union, and the man can walk without even a cane.

Hamilton[34] relates the case of a boy, fifteen years old, falling from a scaffold onto both knees, fracturing the right patella in three pieces and

TABULATED SUMMARY.

No.	Sex.	Age.	Manner of fracture.	Type of fracture.	Mode of treatment.	Result.
1	Male...	36	Indirect	Transverse	Wiring and casts	Good result 4 months after. Flexion: Right knee 90°; left about 70°. Walked naturally on the level.
2	Male...	56	Indirect	Transverse	Suturing	Good result 4 months after. Flexion to right angle. Walks O. K.
3[6]	Male...	..	Indirect			
4[7]	Female..	..	....	....	Old fracture. Passive motion and exercise	Full recovery of limbs.
5[8]	Male...	..	Indirect	....	Splints and strapping	Third day: left in position; right, 1 inch separation of fragments. No other notes.
6[9]	Female..	39	Right indirect. Left direct	Right transverse. Left stellate	Bandages and splints. Passive motion in 7 weeks	Good result. No tendency to lameness.
7[10]	Female..	33	Indirect	....	Straps and splints	Eighteen days, bony union in right. Separation of ¼ inch in left and ligamentous tissue between fragments.
8[13]	Male...	..	Probably indirect	Transverse	....	Good result. After many months recovered without a limp.
9[14]	Male...	..	Indirect	Transverse		
10[15]	Female..	38	Indirect	Transverse	....	Ligamentous union ¼–½ inch. Difficulty in walking up and down stairs. On the level, O. K.
11[16]	Female..	..	Indirect	....	....	Imperfect recovery.
12[16]	Male...	44	Direct	Transverse	....	Fibrous union in both. One inch separation in right; ¾ inches in left. Greatest difficulty in flexion.
13[17]	Male...	41	Indirect and direct	Transverse	Wiring	Good functional action 7 months later.

14[17]	Male...	40	Direct	....	Wiring	Full recovery 6 months later.
15[18]	Male...	22	Direct	Transverse	Inclined plane, adhesive and flour paste rollers	Good results. Both patellæ united by ligaments of about ½ inch.
16[19]	Male...	30	Indirect	Transverse		
17[20]	Male...	28	Direct	Transverse	Splints, starch bandages, passive motion and massage	Fragments united in one month by 1 cm. of fibrous callous. Good result.
18[21]	Male...	..	Indirect			
19[22]	Male...	45	Indirect	....	Wiring. Left rewired 41st day as first wire broke	Thirty-seven days, 90° flexion of right, 70° of left. Left rewired, no final results.
20[23] [24]	Female..	35	....	....	Fragments wired. Prepatellar periosteum sutured with catgut. Massage and passive motion	Two months walking with crutches. In 6 months flexion to a right angle in both knees.
21[25]	....	..	....	Transverse	Suturing	Good result.
22[25]	....	..	....	Transverse	Suturing	Good result.
23[26]	Male...	44	Direct	Comminuted. Right, compound	Left patella removed. Right, 3 fragments sutured with silk, small fragments removed. Posterior and side splints 1 week. Plaster of Paris 4 weeks longer	In 16 months firm union of fragments in right, and flexion to right angle without pain. Left, beyond right angle. Function good.
24[27]	....	..	....	....	Wiring	Very good result.
25[28]	Male...	..	....	....	Compression, immobilization and massage	Bad result.
26[29]	Female..	..	Indirect	....	Wiring	Successful.
27[30]	Female..	..	Indirect	Transverse	Suturing	Most satisfactory.
28[31]	Female..	28	Indirect	Transverse	Sutured with catgut. Plaster-of-Paris casts 6 weeks. Passive motion	Osseous union of fragments and restoration of function.
29[32]	Female..	39	Direct	....	Wiring and patellæ looped	Good results, with flexion to 90°.
30[33]	Male...	..	....	One transverse	One wired, other sutured to patellar tendon insertion	Fibrous union with satisfactory results.
31[34]	Male...	15	Direct	One comminuted	Wiring	Good bony union with good function.
32[35]	Female..	34	Direct	Rt. transverse. Lt. comminuted	Sutured with iodized catgut. Plaster-of-Paris casts	Perfect bony union.

TABULATED SUMMARY.—*Continued.*

No.	Sex.	Age.	Manner of fracture.	Type of fracture.	Mode of treatment.	Result.
33[36]	Female..	30	Indirect	Transverse	Wiring	Firm union resulted.
34[37]	Male...	31	Probably direct	Transverse	Sutured with chromic catgut	Good result. Legs as good as ever. Bend to right angle.
35[38]	Male...	30	Direct	Transverse	Posterior splints and casts. Wired later	Good result after wiring.
36[38]	Male...	..	....	....	One sutured. Other non-operative	Good results.
37[38]	Female..	..	....	....	One sutured. Other non-operative	Good results.
38[38]	Female..	..	....	....	One sutured. Other non-operative	Good results.
39[39]	Male...	41	....	....	Wiring	Good results after four years.
40[41]	Male...	65	Indirect	....	Right wired. Left looped with silk (braided)	Fine results.
41	Female..	35	Indirect	Transverse	Patellæ looped	Good results. Primary union with perfect knee-joints.
42[42]						
43[42]						
44[40]	Female..	37	Probably indirect	....	Wiring	Good result 15 months later.

the left so that a piece turned into the joint, necessitating removal of the piece. Nine days after the accident wiring of the patella was done, and in five months there was good bony union, with good function, allowing him to follow his usual employment.

D. Eve[35] had a woman of thirty-four years, who fell in an elevator, from the third story to the basement, sustaining a fracture of each patella. The right was transverse just below its middle, while the left had one transverse line, as well as an oblique, running into the transverse. Elevation, posterior splints and bandaging comprised the treatment for five days. Then through a longitudinal median incision the torn membranes were sutured close to the bone with iodized catgut, drawing the apposing edges together. The upper part of the patellar tendons were sutured to the lower portion of the quadriceps tendon. Posterior splints were then applied and the legs elevated. After one week plaster casts were applied and allowed to remain for six weeks. Perfect union resulted in both patellæ. Patient soon expected to be on crutches.

Robinson[36] tells of a woman of thirty years, slipping on the stairs, falling forward and was sure she hadn't struck the knees. There was no sign of bruises on the knees, but both patellæ were fractured transversely, the right at the junction of the upper and middle thirds, and the left across its middle. There was fluid and blood in both knees. On the sixth day both were wired, with firm union resulting.

Rutherford Morison[37] reports a young man of thirty-one years, who fell on his face in going rapidly down stairs, with the result of fracturing both knee-caps transversely. There was at least one inch separation. Ten days later he operated, suturing the fragments and aponeurosis with chromic catgut. Gooch splints applied for six weeks. In fifteen weeks the knees would bend to a right angle and he could ride a bicycle perfectly well. Never any pain or stiffness in the knees and he says his legs are as good as ever.

William Sheen[38] writes of a thirty-year-old young man falling down stairs and striking both knees, fracturing each patella transversely. Treated with posterior splints and adhesive plaster for twenty-six days and then plaster casts. When seen by Mr. Sheen he could walk feebly with sticks, so that operation was decided upon, and both knee-caps were wired. About nine weeks later he could walk without crutches and the knees could be bent nearly to a right angle. The final result was good and he had power of going up and down stairs very well.

Lucas-Championnière told Sheen he had three cases of simultaneous fracture of the patellæ. Two were in women and one in a man. In each case one patella was sutured and the other not. As far as he knew all three had, eventually, useful legs. He did not recall the mode of production and they were old cases when he got them.

F. Eve[39] reports the case of a male, forty-one years old, who had broken both patellæ nine months before he saw him. He had been treated by strapping for six weeks, but a subsequent fall left him powerless to walk. There was a separation of three inches on each side. In operating, the insertion of the quadriceps into each upper fragment was divided, the fibrous tissue between the fragments dissected away, and the bony surfaces freshened. The fragments were then wired. Four years later the gaps in the quadriceps tendons were partially filled in and the power of extension was good.

Barcus[40] relates the case of a woman of thirty-seven years, who fractured the right patella and had it wired. About six months later she slipped, fractured the left patella and re-fractured the right. Both were wired and a good result was reported fifteen months later.

Nassau,[41] at a meeting of this Society, January 8, 1912, reported a case in a man sixty-five years of age, who slipped and fractured both knee-pans. Under local anæsthesia the right was wired and the left treated by running braided silk around its fragments. A fine result followed.

Robert T. Morris, in a letter to the writer, tells of a case he had two years ago. He was called by Thomas Byrne to see a woman of about thirty-five years, who in stooping suddenly to pick something from the gutter, fractured both knee-pans transversely, one through the middle and the other through the lower third. After six days he operated through a transverse incision, freeing the inturned fibroid capsule and suturing the patellæ after the Blake method, *i.e.*, "encircling the entire patella with a strand of kangaroo tendon, which brings the fragments into position, when it is tied." There was primary union, with practically perfect knee-joints to date.

Malgaigne[42] states that Camper and Süe each saw a case of simultaneous fracture of both patellæ, but gives no further information.

In summarizing the above cases, I find there are 44. Age was mentioned in 25, ranging from 15 to 65, with an average of 36.6 years. Sex was stated in 39 cases, 23 (59 per cent.) being males and 16 (41 per cent.) females. The manner of fracture is mentioned in 28 cases or 56 patellæ. Thirty-five (62.6 per cent.) of these were fractured in an indirect manner, 19 (33.9 per cent.) by direct violence, and 2 (3.5 per cent.) by a combination of the direct and indirect. The type of fracture is recorded concerning 44 patellæ. Thirty-nine (88.6 + per cent.) were transverse, 3 (6.8 + per cent.) comminuted, 1 (2.2 + per cent.) compound comminuted and 1 (2.2 + per cent.) stellate. Of the transverse type, 19 (48.7 per cent.) were by the indirect manner, 9 (23.1 + per cent.) by direct violence, 2 (5.1 + per cent.) by combination of the two above, and in 9 (23.1 per cent.) cases no statement is made as to the type of fracture.

Of the 68 patellæ (34 cases) concerning which the mode of treatment was mentioned, 17 (25 per cent.) were not operated, 28 (41.2 per cent.) wired, 19 (28 per cent.) sutured, 3 (4.4 per cent.) looped, and 1 (1.4 per cent.) removed. In all, 51 patellæ were treated by an open operative method and each obtained a good functional result. Of the non-operative cases, several resulted rather badly. Case No. 35 in the tabulated summary, originally treated by non-operative methods with a bad result, later had the patellæ wired, thus regaining the function of the limbs.

Wight[16] back in 1884 wrote, " In fact, a patient having had both patellæ fractured at the same time may reasonably expect to become a most deplorable and pitiable cripple." In a letter received from him a few days ago, he shows a marked change in his attitude concerning the above by saying, " The statement you refer to no longer holds good. The modern method of suturing gives a restoration of function, providing the rent in the capsule on either side of the patella is carefully closed to its extreme limits." It is more than evident from the above, that the added risk in the operative treatment in the hands of a skilled operator is far and away outclassed by the good functional result obtained. Operation should not, however, be advised where there is a slight separation of the fragments, in incomplete fractures, nor is the subaponeurotic and longitudinal types, for these almost invariably give good union of the fragments. If there is a contra-indication to general anæsthesia from advanced consumption, diabetes, hepatic or cardiorenal disease, the operation may be done under local or low spinal anæsthesia.

The time of operation varies greatly with different men, ranging from a day to three weeks, the variance being due to the question whether or not it is better to operate before, during or after swelling in the knee-joint.

As to the operation of choice, there is not a great difference so far as the functional outcome is concerned. In the cases herein reported the wiring, suturing and looping methods seem to give equally good functional results. The wiring method, according to Dennis,[43] first done by John Rhea Barton, of Philadelphia, in 1834, and later revived by Mr. Lister, has many advocates.

Andrews[44] speaks of wiring as follows: "The old-fashioned term, 'wiring the patella,' is a misnomer and obsolete, so far as my own practice goes. The patella union is only an incident in the ligamentous and tendinous repair by suture."

In another article[45] he advocates imbricating the free dis-fringes of periosteum and fibrous tissue.

Finally, we observe that simultaneous fracture of both patellæ is a rare condition, occurring in less than 1 per cent. of all cases of fractured patellæ, and that a poor functional result may be expected unless the patient is given the advantage of an open operation where there is enough separation of the fragments, providing asepsis is carried out and the operator is one of ability.

NOTE.—Since preparing this paper a letter has been received from Dr. W. L. Munro, of Providence, R. I., relating the following case of his:

J. L., age thirty-five. On July 5, 1909, a person standing behind the patient struck both knees with his own knees, causing sudden flexion. He tried to recover himself when he "felt something snap" and fell to the ground with fracture of both patellæ.

Operation.—Longitudinal incisions 3 inches, fringe removed, joint irrigated with saline. Edges of the capsule and periosteum, together with lateral reflexion of extensor tendons united with No. I chromic, reinforced by mattress suture No. 3 chromic from the ligament to tendon.

July 20: Plasters cut down and stitches removed. Skin healed perfectly. Excellent result in both patellæ. Line of fracture cannot be felt. Passive motion begun. Considerable stiffness of joints.

July 25: Patient allowed upon crutches. Passive motion continued. Joints limbering up.

July 30: Freedom of motion increasing. Walks with crutches without difficulty.

Aug 2: Discharged.

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UNCOMPLICATED FRACTURES OF THE TARSAL SCAPHOID.*

BY ALEXANDER E. HORWITZ, M.D.,
OF ST. LOUIS, MO.
Visiting Orthopædic Surgeon to the City Hospital.

It is only very recently that fractures of the carpal scaphoid have been prominently brought to our notice, but that of the tarsal is still unnoticed. This paper is therefore merely a plea for the recognition of a fracture which is really of importance and which should be more studied. The vague term " sprain " of the ankle should really have no place in our vocabulary. Any condition deviating from the normal has a definite underlying pathological basis. The old expression " sprain of the back " has happily been discarded, thanks to Goldthwait. The terms " lumbago," " sciatica," and a few others have likewise met their fate. It is now time that the term " sprain of the ankle " should also go, and that in every injury to the foot or ankle a definite diagnosis should be made. Very frequently a weak foot in later life can the more readily be understood and the more rationally treated if its etiology has been properly determined. An injury such as is to be described in this paper is very frequently followed by a weak or flat foot. The ordinary treatment for flat foot, if carried out in this line of cases, is positively injurious. This will be shown later.

Very little attention has thus far been paid by writers to simple uncomplicated fractures of the tarsal scaphoid. Most of the important text-books on fractures ignore it entirely, while one or two merely mention that it is occasionally seen. Where the subject is mentioned the statement is made that it is a very rare condition, rarely seen except in combination with fractures of other bones of the foot, and due to a severe crushing injury.

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* Read before the Medical Society of the City Hospital Alumni.

Uncomplicated fractures of this bone are not as rare as are commonly supposed. They frequently pass as sprains of a severe type. There is usually no total disability following a fracture of the scaphoid, and for this reason a fracture is not suspected. The bone is normally prominent, and the increased prominence is taken as a bruise or synovitis. Crepitus is not one of its common symptoms, motion of the mid-tarsal joints is not greatly limited, and the tenderness is not intense. The greatest discomfort is felt in walking, as in that act the scaphoid, being the highest point of the long arch of the foot, does not give the proper support to the body. A traumatic flat foot, with its train of symptoms, results.

No great violence is required to produce this fracture. A misstep, a turn of the foot, or a moderate blow is sufficient. The break is always found at the tubercle. The tubercle of the scaphoid has a separate centre of ossification and can practically be considered as an epiphysis. This will explain why this injury is more often noted in adolescence, when the epiphyseal line is very active and vascular. Other epiphyseal fractures at this period are comparatively common, and this can be classed among them. Placed as the scaphoid is, at the highest point of the arch, with no support beneath it, it would naturally take less violence to injure it than any other of the tarsal bones. Again, the powerful tibialis posticus is attached to the tubercle, and any undue tension on this muscle would tear this portion of the bone from the scaphoid. These factors will readily explain why the tubercle is the seat of fracture.

Symptoms.—When seen in an adolescent, the symptoms vary to a degree from those seen in the adult. Frequently the original injury has been forgotten, and is not considered to have played a part in the production of the resulting painful weak foot. It is for a "weak ankle" that relief is sought. Upon examination a weak or a flat foot is the condition at first glance noted. It differs, however, from an ordinary weak foot. The abduction is more pronounced and of a painful character. The scaphoid is displaced downward, is thickened and tender. In a flat foot of whatever degree tenderness of the scaphoid is not elicited and is not part of the symptom-complex. The pain across the instep found in flat foot is here also present. Its etiology, the depression of the arch and consequent stretching of the mid-tarsal ligaments, being the same. No tenderness, however, is seen over the tubercle of the calcis, the point of attachment of the plantar fascia, a condition usually noted in an ordinary weak or flat foot. The pain frequently extends up the limb, following the tibialis posticus, whose attachment to the scaphoid has been severed. The antagonistic peronei are now permitted unhindered to contract and abduct the foot. This tonic contraction of the peronei finally leads to a chronic irritation, and a rigidity of the foot in valgus results, comparable to the non-traumatic rigid valgus. In this traumatic case the point of differentiation lies in the tenderness on the inner side of the foot, both muscular and osseous.

Motions of the foot, as a rule, are not greatly restricted in those cases where the peronei have not yet become spastic. Forced abduction is the one passive motion which is limited and painful, as this motion further separates the fragments of the scaphoid and calls for resistance on the part of the traumatized and loosened tibialis posticus.

Where a synovitis exists, and the existing trauma has been of a slight character and forgotten, difficulty in explaining the condition is met. Here it is not uncommon to ascribe it to "rheumatism," a blanket term for many diagnostic sins. Upon examination very little, if any, local heat is found, no general rise of temperature is seen—in short, no sign of inflammation is present. Chronic rheumatism is then considered. But why so limited to one joint? Here, again, the thickened scaphoid, the free mid-tarsal joint motion, the slight peroneal contraction, the moderate tenderness over the scaphoid and tibialis posticus, and the unilateral flat foot help us to arrive at our diagnosis. This lack of disability of the tarsal joints, which as a rule hides the true findings of fracture from us, is the true means of diagnosing this traumatic condition from the ordinary rigid flat foot.

This report is based upon eight cases—four in the adolescent and four in the adult. In none of these cases were the other tarsal bones involved. In the few cases thus far described this injury was always accompanied by one or more of the other tarsal bones, and the trauma always of a severe type. The conclusion had naturally been drawn that fracture of the scaphoid as an entity was rare. This can now readily be disproved.

CASE REPORTS.

Case I.—C. F., female, age 14. Remembers no direct injury. Thinks that one month before any pain appeared in the foot she tripped and fell going up-stairs. Was not disabled. About four weeks later left foot became painful and patient began to limp. Disability increased, and two weeks later she consulted me. The entire ankle, inner and outer side, was œdematous. (This was also noted on the other foot.) Motions at astragalo-tibial joint good, mid-tarsal restricted, in abduction. Adduction good. Tenderness over scaphoid. Walks with decided limp. Both feet flabby, of the underdeveloped adolescent female type. Has been wearing metal plates, and the irritation at the scaphoid was at first assigned to pressure from it. Pain was experienced only in walking. A suggestion of ecchymosis present. Provisional diagnosis: Fracture of scaphoid, corroborated by X-ray. The probable cause of this fracture, the muscular action of the posterior tibial upon the tubercle of the scaphoid.

The metal plate worn by the patient really exaggerated the pain in the scaphoid by direct pressure. The added fact that this pain was noted only during the act of walking corroborates it. From this case and from the following ones we will note that the usual method of treating weak feet by the use of metal plates is in this class of traumatic weak feet very injurious. A yielding, semi-elastic material, such as cork, is the best object to use.

In this case the treatment consisted of padding the foot with felt and bandaging until the tenderness disappeared (about three weeks), and then applying a shoe with a cork pad built in the arch. Massage and exercise.

Case II.—S. H., male, age 15. Stumbled while at play in the school-yard, and caught foot in a hollow. Foot was twisted. Got up and walked, but painfully. Was seen by me the next day.

Tenderness and thickening over the scaphoid. No ecchymosis, slight œdema, no crepitus. Manipulations of foot free, except abduction. Some tenderness over posterior tibial. Long arch on this foot somewhat lower than other (right).

Diagnosis: Fracture of the scaphoid. Confirmed by radiograph.

Case III.—S. D., male, age 13. Fell while playing. Next day foot became painful. Saw him on second day after injury. Foot pained him only in walking.

Symptoms were identical to those seen in Case II.

Diagnosis: Fracture of scaphoid. X-ray positive.

Case IV.—R. F., female, age 15. Remembers no definite injury. Foot painful for four weeks, especially on walking. Pain more marked on turning foot and on walking over an uneven surface.

Thickening and œdema over inner side of foot, tenderness and thickening over scaphoid, no ecchymosis, arch lowered, all motions good except abduction.

Diagnosis: Fracture of scaphoid. X-ray positive.

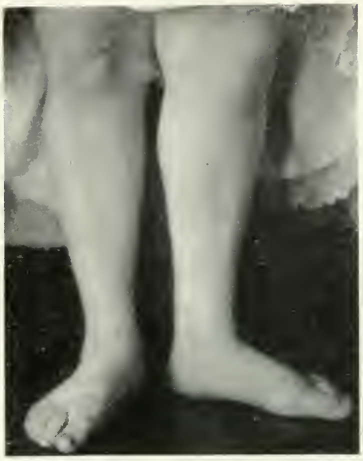
Case V.—E. P., female, age 25, teacher of gymnastics. Turned foot while exercising. Became somewhat swollen and painful. Continued to use foot for three weeks, but with increasing pain. Consulted me three weeks after injury. Slight swelling over ankle-joint, marked tenderness over scaphoid, with thickening over this bone; long arch somewhat depressed, abduction of foot very painful. Other motions of foot good. Ankle motions good.

Diagnosis: Fracture of scaphoid. Confirmed by radiograph.

Case VI.—R. P., female, age 44. In boarding a car which started while patient was on lower step she was thrown forward, striking right foot against upper step. She did not consider herself disabled, and continued her journey, performed her shopping, and returned home four hours later. During this time the discomfort was gradually increasing, and on arriving home I was consulted for a "sprained ankle."

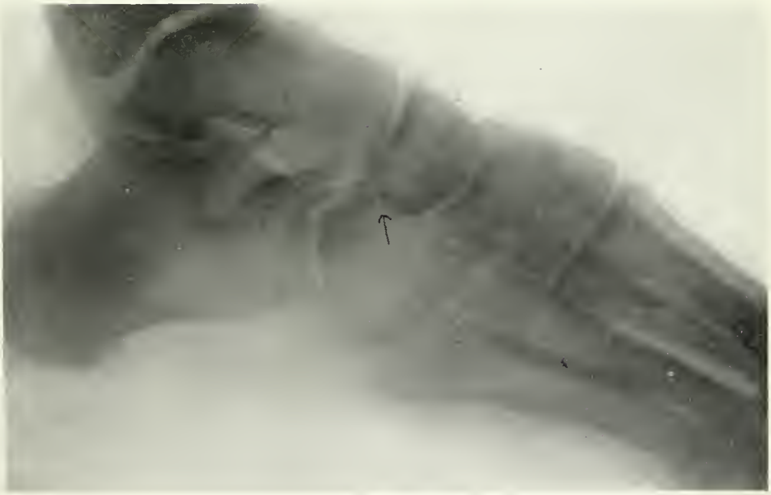
Examination revealed a tender area over the scaphoid, œdema of the tarsus, flattening and thickening of the scaphoid, and tenderness over the posterior tibial. Motions at the astragalo-

Fig. 1.



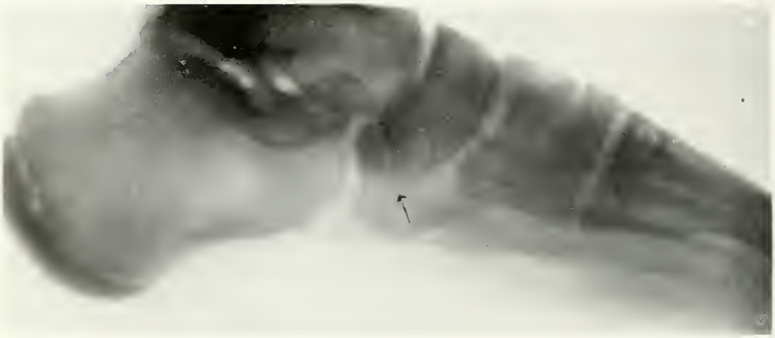
Case I. Traumatic flat-foot (left) resulting from fracture of tubercle of scaphoid (adolescent).

Fig. 2.



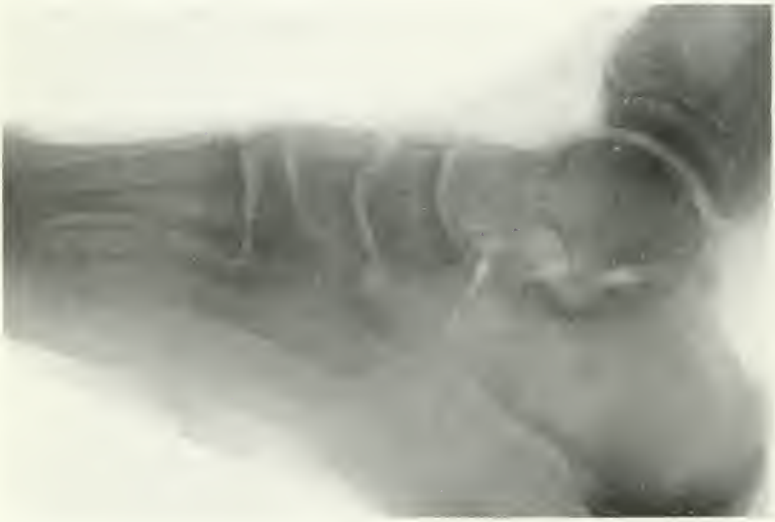
Case I. Fracture of tubercle of scaphoid.

Fig. 3.



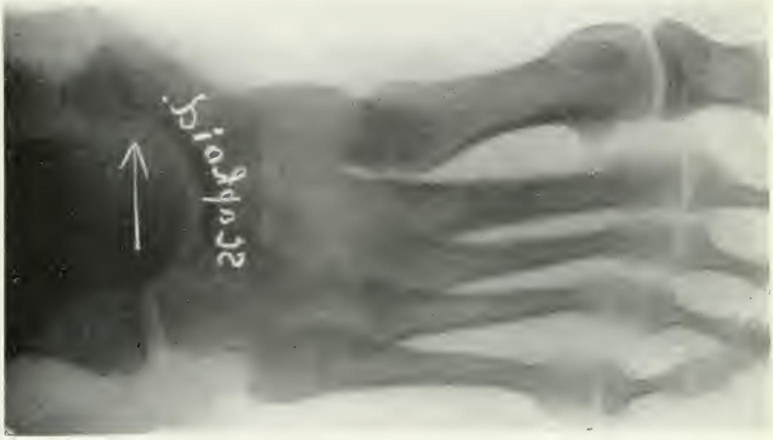
Case II. Marked separation of tubercle of scaphoid.

Fig. 4



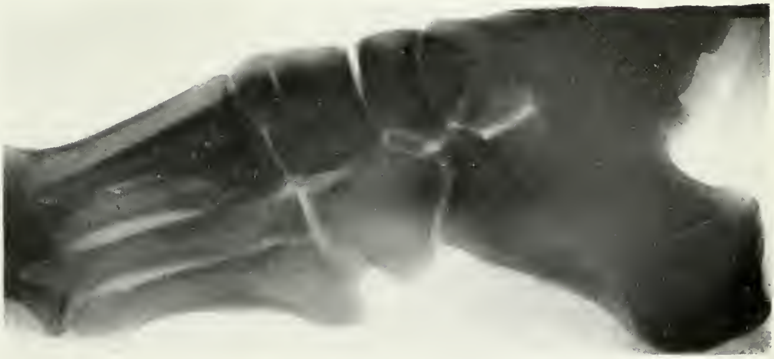
Normal.

Fig. 5.



Case VI. Separation of tubercle, in adult.

Fig. 6.



Case VII. Fracture due to muscle action, in adult.

tibial joint good. At the mid-tarsal joint abduction was painful and limited, adduction good. Slight ecchymosis over scaphoid, no crepitus.

Diagnosis: Fracture of scaphoid. Confirmed by radiograph.

CASE VII.—E. C., female, age 37. Turned foot while walking. Disability immediate, and had to be assisted home. Saw patient two hours later. Foot somewhat swollen, no ecchymosis. Tenderness over scaphoid and up toward leg (over posterior tibial). Flattening and thickening over scaphoid. Abduction of foot painful, other motions free.

Diagnosis: Fracture of scaphoid. Confirmed by radiograph.

CASE VIII.—Mrs. F. B., age 48. About six months ago sprained ankle. Felt uncomfortable for several weeks, but was not laid up. Discomfort has gradually increased, finally ending in what the patient claimed to be total disability. Upon examination the scaphoid was very tender, the arch low, abduction of the foot limited and extremely painful. Other motions of the foot were free.

Patient is of an extremely nervous type, and much of her pain may safely be discounted. The radiograph, however, showed a fracture of the tubercle of the scaphoid, with a wide separation from the rest of the scaphoid.

This patient is still under treatment and prognosis is indefinite.

RECAPITULATION.

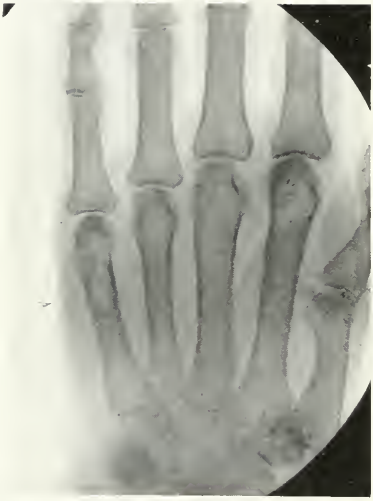
In all of these cases the symptoms were constant, representing an entity. The injury was slight, the disability (with one exception) not immediate. Crepitus absent, ecchymosis slight; scaphoid thickened, flattened, and tender; tenderness along posterior tibial muscle; motions at astragalo-tibial joint not impaired; abduction of foot practically the only motion limited; long arch of foot depressed.

The radiograph in all cases revealed a fracture of the tubercle. No other bones were involved. In all cases a traumatic flat foot resulted.

In the four adolescent cases muscle tension was the only injury. In the adult cases two were of this same class, the other two received injuries of a more severe type. The injuries reported by others were of a severe crushing type which resulted in fracture of several bones or comminution of scaphoids.

The treatment in those cases which were seen immediately consisted in immobilization for ten or fourteen days, followed by massage and felt padding under arch. A cork pad was later built in the shoe; in the cases not seen early strapping and felt pads till pain was relieved, then a cork pad in the shoe. A metal plate such as is commonly used is harmful in this class of lowered painful arch. This produces pressure on the painful prominent scaphoid, and keeps up the irritation. The soft felt pad is to be used until all pain is relieved.

Fig. 1.



Cyst of metacarpal bone. (Arrow points to cyst.)

CYST OF THE FIFTH METACARPAL BONE.

A COMPLICATION OF CHRONIC OSTEO-ARTHRITIS.

BY JOHN R. McDILL, M.D.,

OF MILWAUKEE, WIS.

This case is reported for purposes of record. Since the subject of bone cysts has received so much attention cases are coming to light rapidly, but so far none have been reported in the long bones of the hands or feet. This case is from a woman sixty-five years of age, who has suffered from chronic "indigestion" for forty years; chronic recurrent tonsillitis about as long, and for the last 25 years has had a constantly increasing cardiovascular disease which at present shows a heart enormously dilated and hypertrophied, tumultuous arrhythmia, the cardiac muscles weak and relaxed, and showing considerable degeneration. The osteo-arthropathic changes are not extreme, and are plainly seen in the skiagraph; the attacks that led to them are periodical and are concomitant with appendiceal and gastric symptoms. Wassermann reaction negative. Noguchi's luetin reaction negative. Three years ago a small painless swelling with no discoloration began over the fifth metacarpal bone, and gradually increased for one year when it rapidly swelled, became painful, and was opened, giving exit to stringy mucopus, which as rapidly subsided, and seemed about to heal when six weeks later it opened again near the old incision, evacuating more stringy pus; it was poulticed for one year, during which time it opened every three or six days to discharge a drop or fraction of a drop of a clear fluid; during the last year it discharged about every six weeks; there is no enlargement of the bone.

DIRECT SUTURE OF THE BRACHIAL ARTERY FOLLOWING RUPTURE, RESULT OF TRAUMATISM.

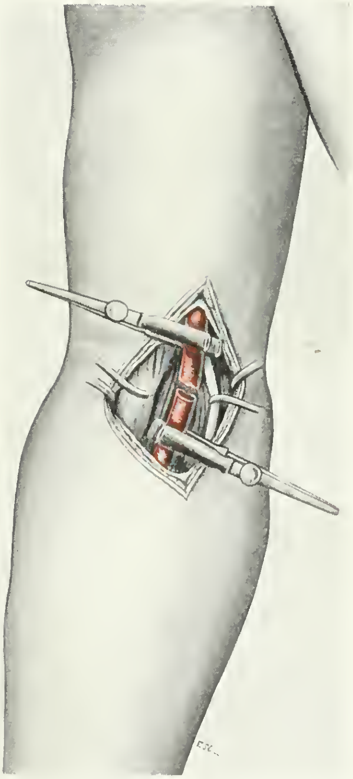
BY J. GARLAND SHERRILL, M.D.,
OF LOUISVILLE, KY.

In view of the recent work in the line of vascular surgery, a study of the results of operation of this nature should prove valuable, therefore the following very interesting case is reported.

On December 31, 1912, the following case came under observation: The patient, a young man, twenty-three years of age, in removing some material from a centrifugal machine had his arm caught and twisted in such a way that a backward dislocation resulted at the elbow. When first seen by the writer about an hour later, he was complaining greatly of pain; there was marked swelling in the forearm, which was purple in color, and also an entire absence of radial pulsation, but there were no symptoms of false aneurism present. Both bones of the forearm were dislocated backward at the elbow. It was at once suspected that the brachial artery had been severed; his arm was at first immersed in hot water for some time to determine whether or not the circulation could be restored. At the end of three hours, there being no improvement and a marked increase in the swelling, an incision was made down to the brachial at the bend of the elbow. The humerus, which was lying in front of the condyle of the olecranon, was restored to its position; the ends of the brachial artery stood forth prominently in the wound, both being filled with blood clot, no fresh blood being present. A small amount of clot was found among the torn muscles.

It seemed to the writer that with the blood vessel occluded a noticeable collateral circulation should have formed by this time, if such result were likely to obtain. Therefore, it was

FIG. 1.



Exposure of wounded artery preliminary to suture.

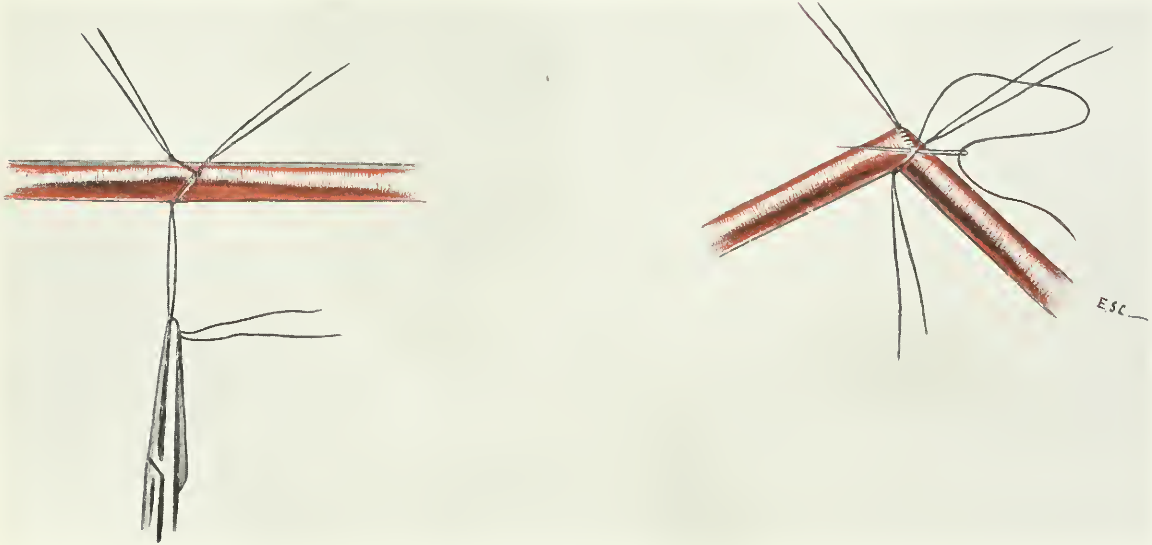
concluded that a direct suture of the torn ends of the artery offered to the patient the best possible chance of saving his arm. The clots were removed from both the distal and proximal ends of the vessel and a Crile clamp then placed upon each to control bleeding during the steps of the operation. It is likely that the clamp on the lower end was not necessary, as that vessel did not bleed when the clot was removed, but its use facilitated considerably the manipulation of the torn vessel. The sheath of the artery was torn away from the distal portion and had contracted somewhat over the proximal end. This was held out of the way while the vessel itself was sutured. In making the anastomosis, the method described by Carrel and employed by Crile was used. A very fine linen thread was separated into its three primary strands, one of which was carried through a very fine round needle (No. 16, Kirby), the thread being previously saturated with sterile vaseline. Three guy sutures were passed through the coats of the vessel; the lower suture was held by a forceps which was allowed to hang down, and the other two caught by forceps which were held by my assistant, thus giving a straight line for the suturing, which was done by continuous suture. The dragging of the forceps below prevented any possibility of catching the wall opposite the line of intended suture. The vessel was turned after each suture in such a way that each side of the triangle was completely closed. After this was accomplished the clamps were released and the blood was allowed to flow, a small amount escaping; an additional suture controlled the hemorrhage and the sheath was drawn down from the proximal side and united to that from which it had been torn below. Following this the clamps were again removed and the blood allowed to flow through the line of anastomosis which it did without any escaping from the vessel.

The median nerve was exposed in the wound but was apparently uninjured. The wound was closed without drainage and the arm put up in a voluminous dressing in a position of partial flexion. Within five minutes after the suturing of the vessel was completed the circulation had returned in the hand, although we were unable to certainly determine a pulse at the radial artery. The patient made a somewhat protracted convalescence and has been disturbed some by the numbness in the fingers, which probably resulted from the stretching of the median nerve. There has also been some slight impairment of motion at the elbow. This is gradually disappearing and it is hoped that he will have complete restoration of function. At the present time the radial pulse is quite as good as in the other arm, and it is possible that the reason it was not felt immediately after the operation was in part due to the swelling and in part due to the fact that there was a slight narrowing of the lumen of the artery at the point of suture, which only permitted a portion of the blood stream to pass. Prompt restoration of circulation in the hand following the suturing and our inability to obtain the restoration of function prior to the operation leads to the conclusion that this boy would have lost his arm had not the direct suture been done. Granting, however, that the collateral circulation might have been restored without anastomosing the vessel, it certainly occurred very much more promptly following the operation than would have been at all likely otherwise.

The writer wishes to express his thanks to Drs. Carrel and Crile for their work along this line and the description of the operative technic which enabled him to perform this operation without any difficulty.

It would seem that this case was of sufficient interest to be recorded and that these gentlemen have opened a field in surgery which will allow the accomplishment of many operations which would not have been considered formerly.

FIG. 2.



Suture of artery. (After Carrel.)

SUCTION TIP FOR ASPIRATION IN ABDOMINAL OPERATIONS.

BY EUGENE H. POOL, M.D.,

OF NEW YORK,

Attending Surgeon to French Hospital; Associate Attending Surgeon to the New York Hospital.

An apparatus for aspiration, described by J. H. Kenyon and E. H. Pool, in *Surgery, Gynæcology and Obstetrics,* December, 1909, is in daily use in the operating rooms of the New York Hospital. The details of the apparatus and its manifold uses were given in that article.

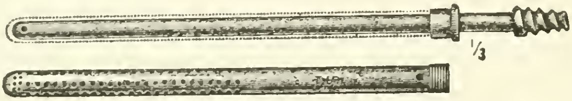
We have found the procedure especially serviceable in operations within the peritoneal cavity for the rapid removal of large accumulations of pus, blood, and other fluids; also, as a substitute for or adjunct to gauze sponging in the removal of small amounts of pus and blood, since its use entails much less trauma to the peritoneum than is produced by sponging with gauze. These applications of aspiration have been adopted by others with some hesitation, because it is not generally understood how any tube connected with powerful suction can be passed into the abdominal cavity without drawing into its lumen intestine or omentum, thus becoming plugged and causing injury to these structures. Such incredulity has led to this report.

The important feature of the apparatus in abdominal cases is the tip, which consists of an inner, suction tube, and an outer, protecting tube. The inner tube has two openings at its tip. The outer tube has numerous perforations in its distal third and several openings at its proximal or outer end so arranged that the hand of the operator cannot occlude them. These openings at the outer end allow a column of air to pass freely from outside of the wound between the outer and inner tubes to the end of the inner tube. In consequence, a vacuum cannot be formed under any conditions. Therefore, while fluids which are not too dense and viscid pass through the lumina of the outer tube to the tip of the inner tube where they are aspirated, the intestine or omentum is not sucked into the fenestrations. In its daily use at the New York Hospital for about six years no recognizable injury has resulted.

Many varieties of tips have been made and tried. The one that has finally proved most satisfactory for routine work is a *straight tip without irrigating tube* (Fig. 1). The irrigating tube has been eliminated as unnecessary. In this respect we have reverted to our original type. In the rare event of irrigation being indicated, a separate irrigating nozzle may be inserted by the side of the suction tip.

A few words in regard to our experience as to structural details may be appropriate. As originally made, the tips presented three objectionable features. The tip of the outer tube was composed of a separate piece of metal cemented to the main tube. It frequently separated when the instrument was dropped. The curved outer end of the inner tube occasionally became acutely bent or broken as a result of rough usage. Finally, the end for connection with the rubber tubing was difficult to adjust. In the present model these disadvantages are avoided. The tip of the outer tube is made of the same piece of metal as the rest of the tube. The inner tube is comparatively heavy and straight with a coarse screw-thread olivary end for connection with the rubber tubing. The straight tube has proved much stronger than the bent, and the olivary end ensures a satisfactory and easy connection with the rubber tube. The tip here described is of convenient size and its strong construction enables it to withstand constant rough usage.

FIG. 1.



Straight tip without irrigating tube for aspiration in abdominal operations.

While suction may be produced by various methods, we use an " ejector " attached to the steam pipe in the engine room, whence a metal pipe leads to the operating room. A non-collapsible rubber hose (known to the trade as " pressure " tubing or " four-ply insertion " tubing) leads from the suction pipe to a gallon bottle under the operating table. It is essential that non-collapsible tubing be used. From this bottle a comparatively short hose of the above material leads to the operating field. When instruments are prepared for operations, the suction tip and the rubber tube leading from the bottle to the field of operation are boiled as routine and are always ready for instant use.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held April 7, 1913.

DR. GWILYM G. DAVIS, President, in the Chair.

SPOROTRICHOSIS.

DR. MORRIS BOOTH MILLER presented a man of 51, who, while engaged in his work, that of handling tin scrap (including old cans) prior to its reduction, received a small scratch from a piece of dirty tin on the flexor surface of his right forearm. This occurred over a year ago and since that time he has had one or more running sores in and about the elbow. While one area would heal another would break down. In consequence numerous scars can be seen surrounding the two or three sinuses which are now present. The area affected is the upper third of the forearm, about the elbow, and slightly above it, but at no time has there been any tendency to spread far from the original point of injury. There has been no involvement of the joint, or indeed to a greater depth than the subcutaneous tissue. The use of the arm is unimpaired in range and strength. The inflammation has been of a low grade and the discharge has always been thin and brownish and rather profuse. The sinuses show somewhat pale granulomata in abundance. Some of these were excised and the presence of the Sporothrix schencki was demonstrated in both of its forms, in the slender branching mycelia from smears and in the ovoid spores, about the size of a red blood corpuscle, in the granulation tissue.

Since this organism was first identified by Schenck, in 1898 (*Johns Hopkins Hosp. Bull.*, 1898, p. 286), it has been recognized as the cause of low grade inflammations of a chronic type affecting man. It also attacks some of the lower animals such as the dog and the horse. It has been carefully studied by the

French observers, De Beurmann and Gougerot, who have recently published a brochure on the subject. It has been observed on decaying vegetable matter and this was probably the source of the infection in the present case. The invasion is through the skin, and it travels along the lymphatics with the development of subcutaneous nodules. The discharge is usually brownish in color and gelatinous in consistency. According to Widal and Weil the spores agglutinate when mixed with serum in dilutions of from 1–200 to 1–500.

The treatment is simple and efficacious, consisting of the local application of dilute solutions of iodine and the internal administration of full doses of iodide of potassium.

SPLENECTOMY FOR BANTI'S DISEASE.

Dr. J. Chalmers DaCosta showed a spleen he had recently removed from a patient who was the victim of Banti's disease. He stated his belief that a very large spleen, if free from adhesions, can be more easily removed than a much smaller spleen, because, when the spleen is much enlarged the pedicle is thrown toward the front and into a region where it is readily accessible. The patient recovered. About 10 days after the operation he developed grievous pains in the ribs, sternum, vertebræ and the bones of the extremities, due doubtless to over stimulation of the marrow. These pains lasted for a number of days. There was a decided leucocytosis.

SUBFASCIAL TUBERCLE.

Dr. DaCosta exhibited a painful tubercle removed from between the fibres of the left great pectoral muscle. It had all the characteristics, clinical and microscopical, of a painful subcutaneous tubercle and yet it was subfascial. The description given by Paget of the symptoms of a subcutaneous tubercle were exactly imitated in this case. Paget's description written more than 50 years ago is still copied by most modern writers.

DENTIGEROUS CYST.

Dr. DaCosta also showed a dentigerous cyst (follicular odontome), removed from the right upper jaw of a negro, eighteen years of age. The X-ray picture, taken before operation, showed a retained tooth under the orbit. The maxilla was short one canine tooth which had not erupted. The cyst was removed intact and the tooth was shown to be well developed. The cyst contained straw colored fluid and the walls contained embryonic dental tissue. Dr. DaCosta exhibited the patient in order to show how little deformity had resulted from the operation.

Dr. Morris Booth Miller reported some further facts regarding my case of symmetrical odontoma, simulating one of the cases reported. After exhibiting this patient to the Academy at the March meeting he operated and found that the overgrowth was solid and apparently made up of cancellated bone tissue, not cystic as he had supposed. It was probably an adamantine odontoma as only the alveolar portion of the jaw was involved. The perfect symmetry and the simultaneous involvement of both jaws characterizes this case as an exceedingly rare form.

OPERATIVE REDUCTION OF OLD DISLOCATION OF THE SHOULDER.

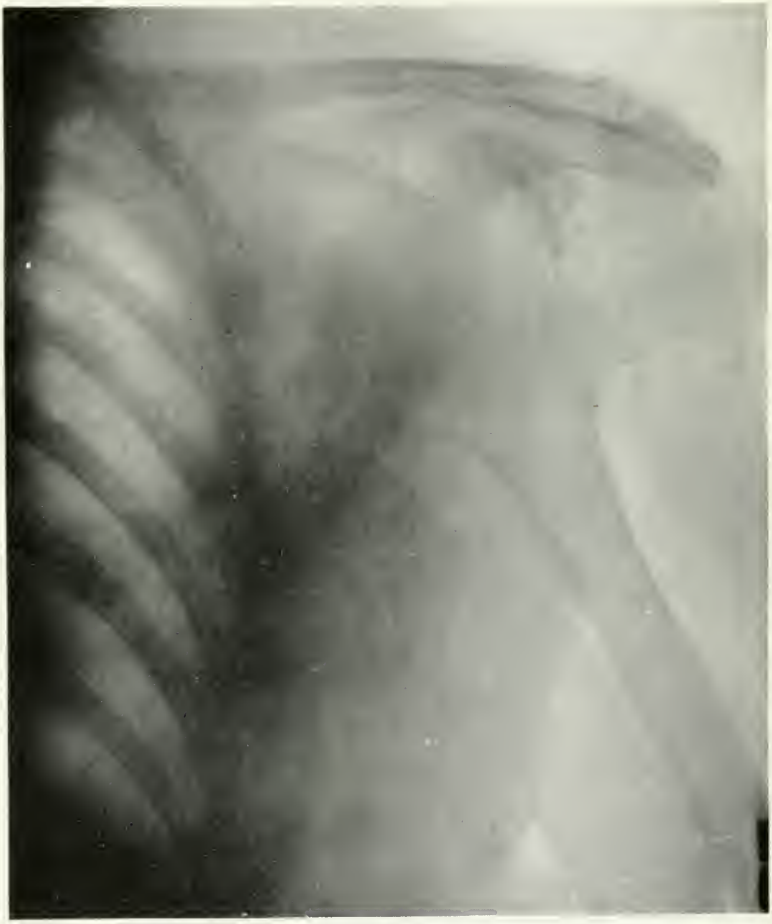
Dr. John H. Jopson reported the case of a woman, aged fifty-eight years, who was admitted to the Polyclinic Hospital November 25, 1912, and discharged January 31, 1913.

She gave a history of a fall and injury of her right shoulder about two and a half months previously. The arm was treated by bandages and fixation for three weeks after which she removed them. Limitation of motion had continued since that time. Examination of the shoulder showed an unreduced subcoracoid dislocation to be present. The usual symptoms of an old luxation were observed, except that pain was not much complained of.

On November 27 reduction under ether was attempted. Prolonged attempts at reduction by the Kocher, and other methods, failed to replace the head of the humerus in the glenoid cavity, although its position seemed somewhat improved. Subsequent examinations showed that the head of the bone was still beneath the coracoid and this was confirmed by radiographs which also demonstrated an old healed fracture of the tuberosities (Fig. 1).

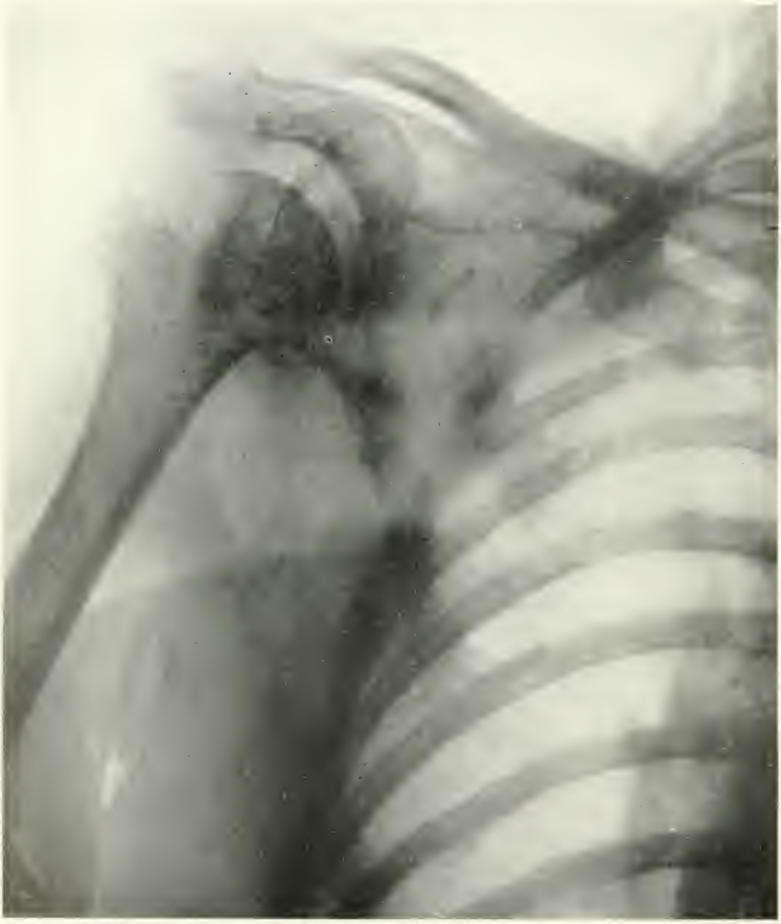
Open operation was recommended and consented to, but owing to the development of an obstinate bronchitis, it was delayed

Fig. 1.



Subcoracoid dislocation of shoulder. Healed fracture of tuberosities.

FIG. 2.



Subcoracoid dislocation. Healed fracture of greater tuberosity.

until January 3, 1913. Through an anterior incision between the deltoid and the pectoralis major muscles the head of the bone was exposed surrounded by an adventitious capsule. There was a healed fracture extending partially through the tuberosities, and a fracture of the anterior inferior edge of the glenoid cavity, which fragment was removed. The capsule was closely adherent to the surface of the glenoid cavity and had to be stripped away from it. The pectoralis minor and coracobrachialis muscles were divided transversely, but the head of the bone could not be brought into its normal relation with the glenoid cavity until some of the anterior and outer fibres of the capsule were also incised, when reduction could be effected, and the capsule was then repaired around the head of the bone. The coracobrachialis was sutured, the pectoralis minor was not. The long head of the biceps tendon was not recognized, and probably not divided. A rubber drain was inserted and the wound was sutured. The arm was dressed in the Velpeau position, in which position there was less tendency for the head of the humerus to slip out of its socket.

The operative result of this case is very gratifying. An X-ray made three weeks later showed the reduction to be perfect (Fig. 2). At the present time, although the patient has had no systematic massage, the restoration of function is progressing rapidly. The patient uses her arm without pain, and is doing some work. There is still marked limitation of abduction, partly compensated by movement of the scapula, but this limitation is decreasing quite rapidly and there is every reason to believe that the final result will be a highly satisfactory one.

Dr. Jopson further remarked that A. F. Jonas reports 11 cases of old dislocation of the shoulder-joint, of which 9 were treated by open incision, reduction being effected in 7 of these, while in 2 the head of the humerus was excised. Hotchkiss operated on 8 cases, reducing 5, after arthrotomy, and resecting 3. In these old dislocations of the shoulder which are not reducible by bloodless manipulations, and this should nearly always be given a trial, arthrotomy offers about 75 per cent. of chances of reduction, while in the remaining 25 per cent. excision will be necessary. The anterior method of approach, either in the pectorodeltoid interspace or as Hotchkiss prefers, transverse division of the fibres of the pectoralis major (Andrews), is the favorite. Muscles which prevent reduction must be divided and can be subsequently sutured. Portions of the joint capsule often require excision. The mortality is very low, almost nil, and while the final result, as Jonas says, leaves much to be desired, there is oftentimes very fair restoration of function along with relief of pain and circulatory disturbances due to pressure.

Dr. T. Turner Thomas said that after study and analysis of the cases he had seen and those he had read of, and of the cadaver dislocation, he had found that the structure which held and which must be overcome to get reduction in these cases was just such a portion of the capsule as Dr. Jopson had mentioned. It ought to be borne in mind, however, that in this case the real trouble still exists, the limitation of movement, and just what the patient will get ultimately is the important thing. In his own work, his trouble was not so much in the reduction as in getting good use of the arm afterward, and he had given up in some cases all hope of normal function. In one case he reported there was a dislocation on each side, one of four years and four months' standing and one of only four months' standing; he reduced the latter without operation but failed to reduce the former; however, the reduced dislocation was later the worse of the two, as it allowed of less movement and gave more pain. As time goes on there are changes in the joint making normal function difficult. Another thing was the fact that Dr. Jopson did not find the long head of the biceps. He had tried to show that the mechanism of the tearing away of the glenoid attachment of the long head of the biceps was the mechanism of the fracture of the greater tuberosity. In his patient with double dislocation, he operated on the reduced side more than a year after the reduction to see if he could improve the conditions, and found the long head of the biceps had been torn away and that the detached end was considerably below its normal level and adherent in its bony groove. It had very much atrophied. He suspected that the tendon in Dr. Jopson's case had torn away and was not cut but was adherent in bicipital groove. So far as he could see the results in this case do not prove that operative treatment was the best for all cases or even for cases after four, five or six weeks, as has been advised by Dollinger, who says that if we divide the subscapularis we can get them back easily.

Dr. John H. Jopson reported that this patient was pretty well satisfied with the result of this arthroplasty and he thought it would be a step backward to leave these patients without operative treatment. There is no reason why in an old dislocation of the shoulder, in addition to the restoration of function, one should not aim to relieve the pressure on the brachial plexus and to relieve the circulatory disturbances and this can only be effected by reduction or excision.

MIXED CELLED SARCOMA OF THE LOWER LIP.

Dr. L. H. Landon, in reporting a case-history, remarked that the occurrence of sarcoma of the lip is apparently extremely rare, although a considerable number of cases have probably been overlooked and taken for epithelioma because of its rarity, difficulty of diagnosis, and lack of, or improper microscopical examination. None of the standard text-books make reference to it, except the 1898 edition of *Duplay and Reclus' Surgery,* in which its rarity is commented upon and two cases reported in both of which there is reason to believe that the growth was primarily of the gum with involvement of the lip. One of these cases, seen by Vidal, was of the melanotic variety, the other reported by Suttegast was mixed celled.

Except for these two cases, a careful review of the literature has revealed but nine cases, only three of which were proven to be true primary sarcoma of the lip.

In 1897 (*New York Post-Graduate,* 1897, vol. xii, p. 346), Coley, in a clinical lecture, showed a little girl aged five. In September, 1896, there was first noticed a small spot resembling a mosquito bite ½ inch below the mucocutaneous line on the right side. Four months later, although not regarded as malignant, it was removed and the specimen preserved in alcohol. In October it began to reappear and an examination then made of the previous specimen showed a round-celled sarcoma. It was then about the size of a pea and markedly indurated. A wide excision was done with recurrence a few weeks later in the scar. Feeling further operation of no avail, she was brought to Coley for treatment with his toxins with later excision of the scar. In April, 1897, the child was free from recurrence.

The second case was reported by Maunsell in 1899 (*Trans. Royal Acad. Med., Dublin, Ireland,* 1899, vol. xviii, p. 326), a mixed celled sarcoma in the lower lip of a female of thirty-two years. It was of three months' duration with no metastasis.

In discussing this case, E. J. McWeenly mentioned a case of lymphangiosarcoma in the lower lip of a child aged ten, suspected by the surgeon of being sarcoma.

In 1909 (*Proceed. Societe Anatomique de Paris,* February 5), Hardouin reported the case of a young woman twenty-two years old, with a large globocelled sarcoma on the left upper lip. The pre-operative diagnosis was angioma. The lip was greatly enlarged and deformed and the growth had infiltrated the muscles of the region.

The difficulty of diagnosis between sarcoma and epithelioma, both clinically and microscopically, is demonstrated by the following case mentioned by Coley (*New York Med. Jour.,* 1891, liii, p. 706), the growth being on the right lower lip of a male of forty-five. The appearance and clinical history pointed to epithelioma; careful microscopical examination by the pathologist reported it as sarcoma. Two months later recurrence in the submaxillary and deep cervical nodes. Excision. The microscope showed the disease to be unquestionably epithelioma which at first had been so disguised by inflammatory reaction that it was mistaken for sarcoma.

The following five cases, together with the one just cited, although occurring in literature on this subject, seem to us either not to have been primarily sarcoma, or to have been sarcoma originating in neighboring structures with secondary involvement of the lip.

A case reported by M. Geraud (*Proceed. Societe Anatomique de Paris,* March 4, 1902). A small tumor removed from the lower lip of a young woman which had developed in about three weeks, had reached the size of a pea, and presented the characteristics of a telangiectatic sarcoma.

A case mentioned by M. Schwartz (*Societe de Chirurgie de Paris,* May 20, 1903), having a fusocelled sarcoma of the cheek involving the lip, in a man sixty-six years of age. The tumor weighed two kilogrammes.

Langston (*Indian Med. Gaz.,* Calcutta, July, 1909) writes of a case resembling macrocheilia, involving the whole lower lip, with an ulcerated, bleeding surface, having many resemblances to lymphangioma-cavernosum. The patient, however, gave a history of always having had a very large lip growing more in the last three years but with no glandular involvement and no secondary deposits anywhere. Microscopically the report was a large celled sarcoma. This was probably a macrocheilia with a nucleus of embryonic tissue, taking on active growth in middle life, or else an angiosarcoma congenital, in which the sarcomatous element had remained dormant for a long period of time and then became active.

Steeves (*Trans. Path. Soc.,* London, xxxvii, pp. 85-86) also mentions the case of a small melanotic growth on the upper lip of a female aged thirty-seven. There had been no previous mole or pigment spot. It was removed with recurrence locally and in the cheek and submaxillary nodes, with death in nine months. Autopsy showed no distant metastasis. The pathological report was uncertain as to whether it was a melanotic sarcoma or a carcinoma-melanodes but as it was composed of alveoli containing epithelial cells with only slight stroma some of the cells of which were pigmented, it corresponded very closely to the description by Kaposi in *Die Hautkrankheiten,* of carcinoma-melanodes, and was probably such.

Eugene Hodenpyl (*Proceed. New York Path. Soc.,* April 8, 1891) presented a microscopical specimen of a tumor removed from the upper lip of a man aged fifty. Five years before a pimple had appeared. It was removed two years later and soon after the present growth occurred. The microscopical findings in this case were remarkable as different portions of the tumor presented respectively, myxomatous, cartilaginous, glandular and sarcomatous tissue, the connective tissue being principally derived from the fibrous capsule.

Prudden said in discussing this case, that hand in hand with the proliferation of the glandular elements, it was not unusual to have a simple hyperplasia of the fibrous tissue. Myxomatous tissue is closely allied to sarcomatous and when hyperplasia is added to this, the difficulty of differentiating it from sarcoma is rendered still greater.

Dr. Landon's attention was first called to this subject by a patient under the care of Dr. Frazier at the University Hospital to which he was admitted October 3, 1912. The patient, an elderly man of 76 years, gave the following history: About two years before he had been stung by an insect at the site of the present sore. A small lesion resembling a fever blister had resulted which under simple treatment seemed to heal only to break out again repeatedly until about four months ago, it began to enlarge and the surface became ulcerated. It had given him no pain. Other points in the history were negative. He did not use tobacco at all and alcohol only moderately.

Upon examination, there was presented a poorly nourished elderly male with the usual evidences of senile changes. Careful examination failed to show any changes other than those incident to his age except in the affected region. On the lower lip, near the mucocutaneous junction and close to the midline was a rounded mass about one and one-half centimetres in diameter, the ulcerated surface of which was covered by a dirty scab, the removal of which left a freely bleeding irregular surface. The base of the growth was indurated; the growth was not tender, and did not extend to or involve the gums. In many respects the growth had the appearance of an epithelioma and was so regarded until the pathological report was received. The submaxillary nodes on both sides were enlarged, hard and partially fixed, the left more than those on the right side. The anterior cervical nodes were also palpable but freely movable. His blood showed a moderate anæmia with 11,200 leucocytes.

On October 7, under intratracheal anæsthesia, through oblique incisions, the submaxillary glands, lymph nodes and lymph bearing tissue were removed and after closure of the wounds, the primary growth was excised, together with a square block of tissue representing a considerable portion of the lip and chin.

The pathological examination of the specimen showed a normal squamous epithelial covering except where the ulceration was present. Beneath this and extending for one centimetre into the subcutaneous and muscular tissue, was an area composed chiefly of spindle cells, arranged in more or less definite bands. The cells were extremely irregular in size and staining qualities. The tissue, entirely cellular in character, presented all the characteristics of a mixed celled sarcoma, apparently of a rather malignant type. At its lower edge the tumor could be seen distinctly infiltrating the muscular tissue.

The lymph nodes showed microscopically almost complete transformation into tissue similar to that just described. Only here and there were portions of normal lymphoid tissue to be seen.

The plan of operation in this case was modified somewhat from that which Dr. Frazier usually employs. Ordinarily a complete block dissection of the anterior triangle of the neck is made, prior to removal of the primary lesion. When the growth is a unilateral one, this dissection is confined to one side of the neck. In the case under consideration, on account of the advanced age of the patient, the dissection was confined to the submaxillary region and did not include the entire anterior triangle.

The patient reacted promptly from the effects of the operation and was discharged from the hospital on the eleventh day. One month later he noticed the appearance of enlarged nodes on both sides along the borders of the sternocleidomastoid muscles, and two months after a second operation was performed at which the infiltrated muscle together with a mass of enlarged glands was removed on the right side. Although only two months had elapsed since the first operation, the progress of the disease had been so rapid that the case was regarded as hopeless and no attempt was made to attack the opposite side.

Pathological examination of the tissue removed as at the first examination showed mixed celled sarcoma of the lymph nodes, the growth appearing to be extremely active.

The patient was discharged from the hospital on December 25, but from then on the rapidity and virulency of the growth were much more marked. The upper lip, tongue, and floor of the mouth became extensively involved and he died on March 3, with still no clinical evidences of distant metastasis.

In considering these cases, three facts stand out prominently; their slowness of growth and apparent insignificance up to the time of operation with little or no systemic effects; their quick recurrence, with greatly increased virulency, following operation; and their apparent localization with no distant metastasis even up to the time of death.

Whether or not in this case the continuation of the lymph metastasis and the eventual outcome of the disease, would have been influenced by a more painstaking and thorough block dissection of the neck, is quite problematical. There was not in this case as in some of the others recorded, any local recurrence but rather an extension to other lymph node groups. In a lymphosarcoma, we are dealing with one of the most malignant of tumors, a lesion in no wise comparable to that of epithelioma, and had the true nature of the lesion been known before the operation, the course pursued might have been modified.

W. J. Mayo (*Jour. A. M. A.*, Feb. 15, 1913) particularly has called attention to the danger and frequency of the traumatic dissemination of malignant disease during operative manipulations, especially those in the breast, gastro-intestinal tract, and female pelvis. Wherever during the removal of malignant growths, it becomes necessary to preserve contiguous structures which are approximated or surrounded by the disease, one cannot expect to separate them or preserve them without carrying and spreading the malignant infection throughout the wound. There is no more favorable seat for this traumatic dissemination and grafting than in the cervical region, where certain important structures must be preserved. The use of the cautery knife is claimed by some to be effectual in preventing the dissemination of the disease during operative manipulations and there is much to be said in its favor. The rapid dissemination of a lesion as malignant as sarcoma is surely to be expected if any malignant cells have been left behind, in a field where so many lymphatic channels have been opened and I am inclined to believe that the use of Harrington's solution may be effective in sealing the lymphatic channels, destroying cells and leaving a less fertile field for cellular proliferation.

SIMULTANEOUS FRACTURE OF BOTH PATELLÆ.

Dr. Carl R. Steinke read a paper entitled "Simultaneous Fracture of Both Patellæ; Report of Two Cases and Review of Literature," for which see page 510.

FRACTURE THROUGH THE TROCHANTERS OF THE FEMUR.

Dr. Astley P. C. Ashhurst read a paper on "Fracture Through the Trochanters of the Femur," for which see page 494.

TREATMENT OF TUBERCULOUS CERVICAL LYMPHADENITIS.

Dr. George P. Müller read a paper with the above title, for which see page 433.

Dr. Astley P. C. Ashhurst said that the main thing in tuberculous cervical adenitis was to recognize that it is not a disease in itself but is secondary to an infection some place else, and one may do all the operations one wants, but if the patients have pediculi or decayed teeth, or infections of the nasopharynx, etc., which are left untreated, recurrence of the cervical adenitis is almost certain. Unless one finds out the source of the infection and cures that, there is little use in removing the secondary lesion in the neck. Whether at an operation one can remove all the lymph nodes he did not know. In the dissecting room he had found them to go down beneath the scalene muscles and across the mid-line behind the trachea, so that it seemed to him impossible to believe that one can take them all out during life in every case. Theoretically, however, the lymph nodes do not extend beneath the deep fascia. The operation always is difficult and should not be undertaken by those who are not good anatomists and who do not know how to dissect.

Hemorrhage may be dangerous and one must be prepared for it. Once he had to ligate the internal jugular vein and the patient was blue in the face from the sudden shutting off of the return flow from the head, and remained in a comatose condition for several days. He had also seen cases where nerves have been injured; one girl at the first operation had the hypoglossal cut and at the second operation the long thoracic nerve.

He is a firm believer in the value of operative treatment in all cases, and at the meeting of this Academy in November, 1908, he reported a case of his own in which temporary paralysis of the left vocal cord followed an extensive operation for tuberculous cervical adenitis; but except for this instance, from which recovery was complete, he has not had the misfortune so far to injure any of the cervical nerves at operation, except sometimes the branch of the facial to the depressor anguli oris.

Dr. Charles H. Frazier thought that Dr. Müller had brought out two important points, first that this condition of tuberculous lymphadenitis is a major condition requiring a major operation and should not be left to the end of a long clinic when the operator is tired out, but should be done when the surgeon is fresh. Secondly, and perhaps most important, is the selection of the time for operation. On so many occasions patients are referred to the surgeon with broken down areas, with mixed infection, it is expected that not only the abscess cavity will be evacuated but that at this time also the lymph nodes will be removed. Dr. Müller has referred to the undesirability of operating at this time; the abscess cavity should be evacuated but the radical procedure should be postponed until this cavity has become obliterated or converted into a simple sinus.

Dr. Emory G. Alexander said that he had used for the past three years at the Mary J. Drexel Home for Children, the tuberculin treatment. The results had been most gratifying and it has reduced the number of operations considerably. In all the cases any source of infection in the mouth, throat and nasal passages, such as carious teeth, hypertrophied tonsils and adenoids were removed, and then the patients were given general hygienic treatment, syrup of iodide of iron, and tuberculin. Of course, the question is open for argument that it is the hygienic treatment, the removal of the source of infection, etc., and not the tuberculin that produces the result; but they never got the results they are getting to-day until they began the tuberculin treatment. They have had no bad effects from the tuberculin, as they begin with a small dose and increase it gradually every five to seven days, watching closely for any marked reaction.

Dr. George P. Müller (in closing) called attention, in regard to tuberculin, to the fact that in many of these cases the element of time is an important one. Operation removes the focus of infection entirely or partially at one stroke and if the operation is performed early and properly, practically every wound should heal within ten days. The patient can then be treated with much greater advantage by the various other methods. Tuberculin treatment without operation is long drawn out, requiring many months or years and at least a weekly visit to the physician or dispensary. An examination of the existing statistics shows results of only about 60 per cent. recovery and improvement, whereas the statistics as shown in my paper give better results from operation. Furthermore, it is probable that many of these patients would have recovered under purely hygienic regulations. There is nothing magical or marvellous about tuberculin. It merely stimulates resistance. Many cases do not do well under tuberculin and sometimes serious results have occurred.

OPERATIONS IN THE CLINIC OF THE PROTESTANT EPISCOPAL HOSPITAL OF PHILADELPHIA.

Dr. Charles H. Frazier read this paper.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, held at the New York Academy of Medicine, April 9, 1913.

The President, Dr. Charles L. Gibson, in the Chair.

CHYLO-ASCITES OF TRAUMATIC ORIGIN.

Dr. Howard D. Collins presented a boy, white, nine years old, who on December 13, 1912, was struck by an automobile. He was brought to the J. Hood Wright Hospital, but his parents wished to take him home, and as no lesion was found, he was allowed to go. He was brought back two days later complaining of some abdominal tenderness, with moderate pain and distention, and a temperature of 102.4°. Within two days his symptoms subsided and he returned home.

The boy was readmitted to the hospital on March 11, 1913, with the history that since December 18, 1912, there had been slight but persistent abdominal distress, with increasing distention and marked loss of weight and strength. Upon examination, the abdomen was found to be much distended by fluid, and in the absence of other signs the case was regarded as one of tubercular peritonitis.

Operation, March 12, 1913: Through a median incision, a large quantity (perhaps 30 ounces) of a white fluid escaped from the general peritoneal cavity, and a loop of small intestine which was exposed showed every chyle radical enormously distended. Upon further exploration, a cystic retroperitoneal tumor was found in the region of the pancreas, and upon incising this, about sixteen ounces of a clear, coffee-colored fluid escaped. The mouth of this sac was sutured to the edge of the incision, and drained with gauze. The boy made an uneventful recovery from the operation, but the abdominal distention recurred and was still very pronounced. The general appearance of the patient had somewhat improved.

Upon examination, the white fluid removed from the abdomen was found to be neutral in reaction; it had a specific gravity of 1008, and contained a heavy precipitate of albumen, a distinct trace of sugar, with fat globules and fatty acid crystals. It was doubtless chyle. The coffee-colored fluid found in the retroperitoneal cyst was neutral, with a specific gravity of 1012, and contained a slight trace of albumen; no sugar. Microscopically it was negative, and there were no evidences of pancreatic ferments.

Dr. Arpad G. Gerster said that from the history of the case shown by Dr. Collins one would be justified to assume that a direct rupture of the thoracic duct had occurred, and such a lesion would be very probable if it could be shown that the distention of the abdomen came on shortly after the injury.

Dr. F. Kammerer said he agreed with Dr. Gerster that the history of Dr. Collins' case pointed rather to a lesion of the thoracic duct, and not to simple compression of the duct by a comparatively small cystic tumor.

Dr. Collins, in reply to a question, said that so far as he could learn from the boy's parents, the abdominal distention came on gradually—not suddenly, as one would expect in a case of rupture of the thoracic duct.

ACUTE PHLEGMON OF THE ASCENDING COLON: BEGINNING INTUSSUSCEPTION OF THE CAPUT COLI, ASSOCIATED WITH THE PRESENCE OF THREAD WORMS. RESECTION.

Dr. Collins presented a negro boy, eleven years old, who came from Trinidad two months ago, and was admitted to the J. Hood Wright Hospital on March 10, 1913, with the history that for two days he had suffered from abdominal pain, paroxysmal in character, and of increasing severity.

Examination showed marked right-sided rigidity of the abdomen, and under ether, a sausage shaped mass, three inches long, could be made out on that side. Upon opening the abdomen in the midline, the ascending colon was found to be greatly thickened, with œdema of its walls, so that the lumen of that section of the gut was almost occluded. There was beginning intussusception of the floor of the caput coli. The lymph nodes of the mesentery of the ascending colon were much enlarged. The appendix and the ileocæcal valve were not involved.

A resection of the ascending colon was done from a point two inches proximal to the ileocæcal valve to three inches distal to the hepatic flexure, with end-to-end anastomosis. The abdominal wound was then closed.

Upon splitting up the excised segment of the colon, it was found to contain many thread worms (oxyuris), with evidences of beginning gangrene at the point of intussusception. The patient made an uneventful recovery, and left the hospital on April 9, 1913.

DOUBLE PERFORATION OF THE DUODENUM.

Dr. Chas. L. Gibson showed a man, twenty-seven years old, of temperate habits, who was admitted to the New York Hospital on February 7, 1913, with the history that for two years past he had been suffering from gastric disturbance, characterized chiefly by pain in the epigastrium, with considerable nausea and occasional vomiting. On the morning of the day of his admission he had had a sudden, sharp pain in the epigastric region and went into a collapse. When Dr. Gibson first saw him, about eight or nine hours later, he complained of intense abdominal pain, but there was nothing definite upon which to base the diagnosis of intestinal perforation.

Upon opening the abdomen, two actively discharging perforations of the duodenum were found, one at the pylorus, the other about an inch lower. They were both closed with purse-string sutures, and although these seemed to give rise to a slight constriction, Dr. Gibson said he refrained from doing a gastro-enterostomy, which he thought was seldom indicated in dealing with these acute cases.

The man made a perfectly normal recovery, and left the hospital in ten days. At that time he was eating solid food and was entirely free from gastric symptoms. Whether a gastro-enterostomy would eventually become necessary in this case remained to be seen.

CERVICAL RIB.

Dr. Gibson showed two cases of cervical rib, one in a male, the other in a female. The speaker said he had seen four examples of this anomaly in a comparatively short space of time.

and he simply showed these, together with the radiographic findings, in order to emphasize the frequency of a condition which was so often overlooked.

These patients sometimes had more or less throat or pulmonary irritation, due to the presence of the supernumerary rib, and in one of his cases the patient had been rejected for life insurance because of suspected pulmonary trouble. Dr. Gibson said that in one of his cases, which he was unable to show, the condition was bilateral.

Dr. Kammerer said that about thirteen years ago he showed a case to this society, in which he had removed a cervical rib that had caused serious pressure symptoms, evidently producing a thrombosis of the brachial artery or its branches. The pulse in the vessels of the arm was absent before operation and had not returned some time after a portion of the rib had been removed. All the symptoms referable to pressure on the plexus were, however, permanently relieved in his case.

SARCOMA OF CLAVICLE—EXCISION FOLLOWED BY TOXIN TREATMENT.

Dr. William B. Coley presented a boy, twelve years old, who came to the Hospital for the Ruptured and Crippled on December 16, 1912, with the history that five weeks previously he had fallen off a stepladder and struck the region of the right clavicle against a wooden box. Two weeks later a swelling appeared on the inner extremity of the right clavicle; it was painless, apparently attached to the bone and had rapidly increased in size.

Examination on December 17 showed a tumor, about the size of a hen's egg, markedly protuberant in the region of the sternum and right clavicle. It apparently involved the inner half of the clavicle and occupied the entire suprasternal region. It was soft in consistence, almost fluctuating in some parts, denser in others. The skin was not adherent, but the superficial veins were considerably dilated.

Dr. Coley said he made a clinical diagnosis of periosteal sarcoma of extreme malignancy, and advised total excision of the clavicle. The X-ray photographs showed almost complete destruction of the inner third of the right clavicle. The operation was performed on December 20, 1912, an incision being made beginning just above the sternum, over the inner junction of the tumor, and carried around to the outer extremity of the right clavicle, down to the normal bone, and the clavicle was then sawn through about two inches from its outer extremity. Lifting up the inner portion by means of a lion-tooth forceps, the tumor was carefully dissected from its deep attachments. There was practically no bleeding. The growth was extremely soft in areas, and a small portion of it exuded through the wound. There was very slight shock. The wound was closed, with cigarette drain.

The specimen was submitted to Dr. James Ewing, who reported as follows:

> Specimen consists of clavicle which fractured about the middle point, where it runs directly into the tumor mass. Periosteum strips easily; shaft of bone is eroded beneath it. The outer end of clavicle is largely destroyed by tumor growth, which has split up layers of periosteum and bone shaft, and invaded the surrounding muscle for a distance of one-half cm., producing a rounded tumor in this region.
>
> The gross appearance is not distinctive of either central or periosteal sarcoma. The outer end of the bone is much thickened, and the bone is irregularly absorbed. Through the centre of the globular mass of tumor runs a sharp, white line, indicating periosteum, beyond which the tumor infiltrates muscle and fat.
>
> *Histology.*—The tumor belongs in a class commonly called small, round-celled sarcoma. The cells are small, 10–12 micr. in diameter, with poorly defined cytoplasm, hyperchromatic vesicular nuclei. The shape, where preserved, is polyhedral; cell bodies are clear; arrangement is diffuse, the cells often sheathing numerous small blood vessels. Size of cells remarkably uniform. One large artery is filled by mural tumor thrombus. Muscle extensively invaded and destroyed by diffuse focal growth of tumor cells. Histological indications are highly malignant. Exact source of the cells undetermined.

Ten days after the operation there was a marked swelling at the site of the old tumor, having every appearance of a local recurrence. The patient was then put upon the mixed toxins, which were continued daily until a reaction of 102° or 103° F. was obtained. At the end of two weeks the swelling had disappeared, and there had been no return. The toxins were continued for two months, and then the treatment was left off for two weeks, during which interim the patient gained rapidly in weight. The toxins were then resumed, and the second period of treatment terminated a week ago.

Dr. Coley said his first case of round-celled sarcoma of the clavicle in which he performed total excision was shown at a meeting of the New York Surgical Society about two years ago. That case bore a striking similarity to that shown to-night in the fact that it followed almost immediately after a trauma. In that case the injury was not a direct blow, but a severe strain caused by the patient trying to save himself from a fall by catching hold of the stair-banister with his left hand. The tumor in that case, apparently, was of periosteal origin, and about the size of an English walnut. There was no pain until about three weeks before the operation. Before leaving the hospital the patient was put upon the mixed toxins of erysipelas and bacillus prodigiosus, and the treatment was continued in small doses by his family physician for three months longer. At the present time, nearly three and a half years later, the patient remains in good health and an important engagement prevented him from being present this evening.

Dr. Coley said that of the ten cases of sarcoma of the clavicle that had come under his personal observation, eight gave a distinct history of an antecedent trauma. Sarcoma of the clavicle was apparently one of the most malignant of all new growths. Norkes, in 1893 (*Beitr. z. Klin. Chir.*, Bd. xi, p. 729), was able to collect 32 cases of total excision of the clavicle for malignant disease, to which Dr. Coley, in his paper read before the American Surgical Association in 1910, was able to add 20 further cases found in the literature, and twelve unreported cases, including one of his own.

As to the results, eleven of the cases died of the operation. In seven a recurrence was noted within the first six months after operation. Only six were well at the time of observation. Only three of the 64 were known to have been permanently cured, one fifty years, one ten and one five years. (The case of Dr. Delatour, well five years after excision, had escaped Dr. Coley's notice when he published his paper.)

Since the publication of his paper in 1910, the number of cases well beyond three years had been somewhat enlarged. His own case had now remained free from recurrence for over three years; the case reported by Dr. Maurice H. Richardson, of Boston, was well over five years, and the case of Dr. Thomas W. Huntington, of San Francisco, was well four and a half years. It was interesting to note that in the three latter cases the toxins were used for a considerable period after operation.

The further experience with sarcoma of the clavicle and the longer period of observation of after-results only tended to still further confirm the conclusions which Dr. Coley said he had expressed in his paper in 1910; these were:

1. That primary sarcoma of the clavicle, while a rare condition, required very early diagnosis and very radical treatment—total or partial excision as soon as the diagnosis had been made.

2. That the mortality of the operation performed under modern aseptic conditions should be very small.

3. The danger of early local or general metastases was very great.

4. In view of the favorable results obtained in the few cases of sarcoma of the clavicle, and the much larger number of sarcoma of the long bones in general by the use of the mixed toxins of erysipelas and bacillus prodigiosus immediately after operation as a prophylactic, such use would seem to be strongly indicated as a routine measure.

INOPERABLE ADENOCARCINOMA OF THE SOFT PALATE, RENDERED OPERABLE BY THE USE OF THE MIXED TOXINS.

Dr. Coley presented a man, fifty-two years old, who was referred to him by the late Dr. William F. Dudley, of Brooklyn, on June 1, 1912. The patient had always been well until six months before, when he noticed a swelling just behind the soft palate. This was treated by Dr. Dudley, but the growth continued to increase in size.

When Dr. Coley saw the patient, in June, 1912, the soft palate was pressed forward, bulging into the cavity of the mouth. The space behind the palate was practically filled by a large tumor which interfered considerably with speech and swallowing. On palpation, a smooth, rounded tumor was found; it was moderately firm in consistence, situated behind the soft palate and extending backward, but its point of origin could not be made out. The patient was admitted to the General Memorial Hospital two days later and was put upon the mixed toxins, the injections being made in the pectoral region. A week later an exploratory incision was made in order to obtain material for microscopic examination. This was submitted to Dr. Ewing, who reported as follows:

> I think the tumor of the palate must stand as an adenocarcinoma. It is made up of small alveoli lying in hyaline or mucoid struma Most of the alveoli are intact; some are carcinomatous and diffuse. The tumor probably arises from the mucous glands of the palate. It is not at present very malignant, and a thorough extirpation ought to cure.

The mixed toxins were continued locally and systemically, and under this treatment the tumor showed marked diminution in size and became less diffuse and more discrete, so that its outline could be more easily defined. It also became harder in consistence, so that the needle entered with difficulty. The local injections produced fairly severe reactions, a temperature of from 102° to 104° being obtained with from one-third to one-half mm. doses.

In view of the decrease in size of the tumor, the patient was operated on August 1, 1912, under ether anæsthesia and after preliminary ligation of the external carotid. Through an oblique incision through the soft palate, two and a half inches long, an attempt was made to remove as much as possible of the growth. It was about the size of a small egg, fairly well encapsulated, and extended backward and downward for about two inches. It was found impossible to remove the capsule, and the curette and scissors had to be employed. The wound healed rapidly and the patient was sent to the country for two weeks to recuperate, after which he resumed his occupation.

An examination, made on April 7, 1913, showed nothing but scar tissue at the site of the wound. The toxins had been continued, twice weekly, by his family physician, which in no wise interfered with the patient's occupation. His general condition is good, and he now weighs more than at any previous time.

A second microscopic examination, made by Dr. Ewing, confirmed the diagnosis of adenocarcinoma.

Dr. Howard Lilienthal said his experience with Coley's fluid, both in inoperable sarcoma and as a post-operative precaution against recurrence in carcinoma, had convinced him of its value. In a case of lymphosarcoma of the ileocæcal region where he resected the malignant growth and did an ileocolostomy, and where complete extirpation of the involved tissues was manifestly impossible, Coley's fluid was used as a post-operative measure, and the man apparently entirely recovered. Four years later he developed a lymphosarcoma of the left tonsil, which was operated on by Dr. Charles A. Elsberg, who removed as much of the involved area as possible. The patient was again put on Coley's fluid, and he again rapidly improved in health and had now remained well for two years.

These and other similar experiences, Dr. Lilienthal said, had convinced him that this method of treatment had not received the credit it deserved.

HYDROCELE OF THE TUNICA VAGINALIS: TWO RECURRENCES AFTER THE WINKELMANN OPERATION.

Dr. A. V. Moschcowitz presented a boy, eleven years old, who was operated on for a hydrocele of the tunica vaginalis at a hospital in a neighboring city five years ago; the condition soon recurred and three years later he was again operated on by the same surgeon, and again the operation was followed by a rapid recurrence.

Dr. Moschcowitz operated on the boy at the Har Moriah Hospital on March 21, 1913. On account of the two preceding Winkelmann operations, the third operation was exceedingly tedious and difficult, but he finally succeeded in extirpating all of the parietal serosa. At the same time he extirpated an empty hernial sac which extended into the scrotum, and closed the inguinal canal in a radical manner.

This case, Dr. Moschcowitz said, was presented in connection with a discussion of this subject which took place before this Society on November 8, 1911, when Dr. H. H. M. Lyle presented a case of hydrocele in which a recurrence had taken place after the Winkelmann operation, and had referred to three additional cases out of a series of ten in which there had been recurrences. At that time, some of the members who were present spoke against the Winkelmann operation, while others favored it.

OMENTAL GRAFTING TO REPLACE SEROSA AND MUSCULARIS OF SMALL INTESTINE.

Dr. Moschcowitz presented a man, twenty-one years old, who was admitted to the Mt. Sinai Hospital on March 3, 1913, with the indications of an acute appendicitis. He was immediately operated on by the house surgeon, who, upon opening the abdomen, had considerable difficulty in finding the appendix, and encountered at least four discrete abscesses, which were opened. Dr. Moschcowitz, who was awaiting the progress of the operation, noticed an adherent loop of small intestine, fully six inches in length, which was exposed in the wound, still attached to its mesentery, but absolutely devoid of any serosa or muscularis. He thereupon took charge of the operation personally, and found that the appendix was situated retrocæcally. As the outlook of a resection of devitalized segment of the intestine in such an infected field and with such extensive adhesions did not seem very promising, he brought into the field of operation a liberal portion of the omentum, and with it completely covered up the denuded loop, fastening it both in front and behind and at its two extremities with a few interrupted catgut sutures. The wound was drained with gauze, tubes and a rubber dam, but all disposed of in such a manner that nowhere did the gauze come in contact with the denuded loop of intestine or its new omental covering.

The patient was kept constipated for the first four days, and thereafter the bowels were moved with enemata. Gradually, all drainage was removed. There was no leakage, and no interference whatsoever with the bowel functions; in fact, the patient's convalescence was absolutely perfect in every respect, and he was discharged on April 6, 1913.

Dr. Moschcowitz said this case was presented in connection with the case of ileus which he showed two or three months ago, where the condition was caused by the tearing away of about four inches of small intestine from its mesentery. In that case, the intestine evidently remained viable through the influence of the omentum that had become adherent to it, but eventually, by cicatrization, the bowel had become contracted to such a degree that intestinal obstruction had occurred. The present case was a further example of how a loop of intestine could be kept viable by omental grafting. This patient would be kept under observation, and should any complications arise, he would be glad to report them to the Society.

CYST OF THE TAIL OF THE PANCREAS.

Dr. Moschcowitz presented a girl, thirteen years old, who was admitted to the Har Moriah Hospital on February 17, 1913. Both her family and past history were negative, and there was no history of any trauma. Ten days ago the girl began to complain of cramp-like pains in the left half of the abdomen. Upon the application of heat, these pains ceased for a time, only to recur with increasing severity. She vomited repeatedly and suffered from constipation, although her bowels could be moved with the aid of enemata.

On physical examination there could be seen and felt a large tumor which occupied the middle and lower thirds of the left abdomen. The mass was ovoid in shape and approximately the size of a large cocoanut. On account of the rigidity of the overlying abdominal muscles, its exact contour could not be well defined. It was very tense, of indefinite consistence and not very tender. It was slightly if at all movable and could be distinctly felt per rectum.

In the absence of any previous history, the diagnosis was believed to lay between a mesenteric cyst and a twisted ovarian cyst, with the probabilities in favor of the latter.

Operation, February 19, 1913: With the patient in the Trendelenburg position, through a median suprapubic incision which later had to be extended to a distance of about eight inches, it was found that the uterus and adnexa were perfectly normal. A large cystic tumor was seen extending from the pelvic brim upward and covered by adherent omentum. This was liberated from the cyst by blunt and sharp dissection. The cyst was so large and unwieldy as to preclude its extirpation *en masse,* and even its exact anatomical relations could not be definitely made out. It was thereupon aspirated, and fully two quarts of a clear fluid were evacuated. It could now be made out that the upper limits of the cyst extended beyond the stomach, into the angle formed by the pancreas and spleen, and as it was gradually freed from its attachments, the splenic vessels finally came into view as well as the tail of the pancreas, from which the final pedicle was excised. The entire wound was closed in layers, without drainage. The patient made an uninterrupted recovery, and was discharged on March 9, 1913.

Histologically, the wall of the cyst was found to consist of dense connective tissue, containing abundant young connective tissue cells, fibroblasts and plasma cells. The inner lining of the cyst consisted of granulation tissue containing many newly-formed blood vessels. There was no epithelial lining to the cyst. In one or two of the sections taken from the neighborhood of the pedicle, distinct pancreatic alveoli were found.

BLOOD INJECTION FOR CURE OF UNUNITED FRACTURE.

Dr. Arpad G. Gerster, in presenting this case, said experience with compound fractures in the human, as well as in experimental work on animals, had amply shown that the presence of effused blood about the fragments played an important part in the formation of an adequate callus. Based upon this circumstance, Bier had recommended the injection of fresh blood in tardy union after fractures. This treatment was so simple, and in the case shown had such a good result, that it was deemed to be worth while to present it to the Society.

The patient was a painter, forty-two years old, of prematurely senile habitus, who, six and a half months before admission to the hospital, sustained a fracture of both the tibia and the fibula. Ever since then his limb had been encased in plaster of Paris, which was applied at another hospital. The leg was encased in several layers of crust and dirt, beneath which two ill-conditioned, retracted granulating defects existed. The tibia showed good apposition, with no longitudinal displacement, while the fibula showed both lateral and longitudinal displacement. There was marked false mobility, and the X-ray showed no traces of a callus.

By the condition of the leg, any bloody procedure of osteoplasty was rendered extremely hazardous, while it was easy to prepare sufficient space for the performance of a subcutaneous blood injection. Hence, on January 28, 1913, the following procedure was carried out: By previous acupuncture with a fine needle, the exact site of the fracture was established; this needle was left inserted between the two tibial fragments and served as a guide for the proper placement of the injection. Then, with an ordinary aspirating syringe, armed with a stout needle, about an ounce and a half of blood was directly withdrawn from the patient's median vein. The guidance of the previously inserted needle rendered prompt and precise injection of the blood very easy, so that this was accomplished before coagulation. Considerable pressure had to be used to expel the blood. The puncture was protected with a small patch of iodoform gauze, the leg being put up in plaster.

No reaction followed, and a day or two later the patient was made to walk. On February 20 there was marked lessening of false mobility. As a double hernioplasty was done on that day at the patient's request, the anæsthesia was used for depositing another ounce of fresh blood at the site of the delayed union. By March 15 the leg ulcers had healed, and the deposit of a good callus became evident. The skiagram showed an interesting condition: First, the absence of any callus whatever about the fibula, which had not received any special treatment. Secondly, an abundant, spindle-shaped callus encasing the fragments of the tibia (like a plumber's splice), the line of pseudoarthrosis between the fragments remaining clearly marked. This demonstrated that the fractured and apposed surfaces remained unaltered and ununited by bony deposit, and that the firm union of the fragments was due to an external callus.

Dr. Henry H. M. Lyle said he had used the Bier method ot treatment in three cases of double fracture of the lower extremity, two of them compound. He believed that this method should always be given a trial before either bone grafting, or bone plating were resorted to, and he had seen it succeed where the latter had failed.

Dr. Lyle said that he had experienced some difficulty in carrying out the technic as described by Bier, and he now used a slight modification which made the procedure very simple. The only drawback to Bier's original technic was that the blood clotted rather quickly which in some cases interfered with the thoroughness of the work. To overcome this drawback he drew up some warm sterile albolene through the needle into the syringe and then expelled it, leaving a fine film of albolene covering the needle and syringe. This film prevented the clotting in the syringe and needle, thus allowing a careful, accurate and thorough injection of blood around and between the fractured ends. He considered this small detail a great aid in carrying out this most valuable method of treatment.

PATENT URACHUS AND EPIGASTRIC HERNIA.

Dr. Gerster presented a man, fifty-two years old, a pedler, who four years ago contracted a swelling above the umbilicus. Since childhood he had noticed a slight leakage from the umbilicus whenever the bladder became distended. On admission, a large, easily reducible epigastric hernia was found just above the navel. A fine probe readily penetrated the apex of the inverted cone of the umbilicus, and cystoscopy showed that it had entered the fundus of the bladder through a conical elongation of the fundus upward, terminating in a shape like the entrance into a vesical diverticulum.

On March 6, 1913, two semi-elliptic incisions were made circumscribing both the epigastric hernia and the umbilicus, and penetrating all the components of the abdominal wall. The hernial contents, consisting, as usual, of parts of the round hepatic ligament, were replaced. Then the two incisions were united below the navel, and the cut line was extended downward two and a half inches further. It was noticed that under the parietal peritoneum a conical mass extended downward from the navel, widening gradually like a funnel into the full size of the bladder; in fact, that this funnel represented the fundus. Thus we might say that the bladder opened directly into the navel unless the umbilical end of the funnel were to be accepted as the urachus. The navel was severed from the top of the bladder directly below the skin, where the calibre of the funnel was about two millimetres. This was bent upon itself, depressed, and buried under three tiers of catgut sutures. Then the abdominal parietes were closed by the usual layer sutures. A small drain was placed against the apex of the bladder and withdrawn on the third day. For a few days the bladder was catheterized every six hours. Primary union followed. A skiagram of the bladder filled with collargol showed that the fundus had now resumed a normal domelike shape.

URINARY INFILTRATION AFTER RETROPERITONEAL URETEROTOMY.

Dr. Gerster presented a man, thirty-one years old, who entered the hospital with typical symptoms of a ureteral calculus, the diagnosis being confirmed by X-ray and ureteral catheterization. On November 16, 1912, by ureterolithotomy, a calculus was extracted from the ureter midway between the kidney and bladder. The ureter was left patent, and by inadvertence, cigarette instead of tube drainage was employed. The wound was not disturbed until the fourth day, when, on withdrawing the drainage, large quantities of turbid urine were set free, escaping from the retroperitoneal space.

Copious suppuration followed, indicating retention. Hence, on December 12, the entire wound was reopened. A channel was found leading upward toward the kidney, another directly toward the spine and a third one downward into the pelvic retroperitoneal space. By December 31 the two upper tracts ceased discharging, but not so the pelvic sinus. Per rectum, a probe introduced into the sinus could be palpated through the posterior rectal wall. To drain this pocket, the coccyx was excised, and direct drainage was established by a retrosacral incision. This incision contracted rapidly and became inadequate; hence, on March 7, 1913, the sacrum was exposed and its lower half, on a line with the third pair of sacral foramina, was chiselled through and removed. This gave free exposure to a large cavity filled with exuberant granulations and pus, lying between the rectum and peritoneum anteriorly and the remnant of the sacrum posteriorly, which was curetted and packed. By this time the incision above Poupart's ligament had closed, and from now on the discharge from the presacral cavity became scanty and serous, also closing rapidly, so that the patient was discharged, cured, on April 6, 1913.

PULMONARY ABSCESS; COSTAL RESECTION AND IMPLANTATION OF SCAPULA.

Dr. Gerster presented a boy, nineteen years old, who nine months before admission had had pneumonia and pyothorax, for which drainage by intercostal incision was done at another hospital, from which he was discharged three months after operation with a small sinus. This had closed and reopened several times.

When the boy was admitted to the Mt. Sinai Hospital, on November 8, 1912, he was in a wretched general condition, with hectic fever and night-sweats, and exhibiting a retracted right chest with a narrow aperture in the seventh intercostal space, from which issued a copious discharge of pus. About a week later, broad drainage was established by the resection of short segments of the seventh, eighth and ninth ribs. The cavity had two compartments, one running forward and upward, the other backward and upward toward the spine. Gradually, the discharge and fever diminished, but the boy's general condition did not improve. On December 14 the fever again rose, together with an increase in the flow of pus, and three days later short segments of the fourth, fifth and sixth ribs were resected in the space between the spine and the inner edge of the scapula, exposing the tract leading upward and inward. A thick coat of organized exudate covered the lung. Fluctuation being evident, this coat was incised, when a huge cavity, easily admitting the fist, was opened, from which there escaped about a pint of pus. This probably represented an interlobar deposit. Immediately, the patient's temperature fell, and improvement of the general condition became noticeable.

To close the large cavity, the procedure was divided into two steps: First, on February 1, to limber up the lower portion of the thorax, additional long segments (between seven and eight inches) of the eighth and ninth ribs were resected. Two weeks later the final and more extensive operation was done. The conditions then existing were as follows: Between the inner margin of the scapula and the spine, extending from the level of the fourth rib downward to that of the ninth rib, there was a defect of the thoracic wall giving entrance to a cavity located mainly under the scapula and extending laterally and forward to the axillary line, the ribs and scapula forming a sort of overhang. In the bottom of this cavity there lay exposed the collapsed lung, covered with a thick, fibrous deposit. Into the lung there penetrated a sinus which admitted the probe to the depth of an inch and a half. The main impediment to the approximation of the ribs to the collapsed lung was the integrity of the costal structures underlying the scapula. To eliminate the rigidity of this portion of the thorax an incision was carried down to the level of the ribs along the inner margin and the apex of the scapula, which was then easily detached from the thorax and turned over and outward like a trapdoor. Then, beginning from the eighth rib and going step by step upward to the third rib, each rib was resected in proportion to its entire length, so that about eight inches were removed from the seventh rib, and two inches from the third rib, the anterior line of the section of the ribs corresponding to a vertical line placed a little forward of the axillary line. Naturally, the resection of the three uppermost ribs was done in the axillary cavity. By removing the third rib, the extreme apex of the cavity was broadly exposed. As soon as this was done, it was very easy to return the scapula to its natural position, and then to depress and engage its inner margin under the short costal stumps that had remained attached to their spinal articulations, so that the inner scapular margin was overlapped by these costal stumps. This manœuvre filled up the gaping cavity, and brought, as it were, the subscapularis muscle into close contact with the lung surface, the divided intercostal structures offering no resistance to close apposition. A large drainage tube was placed well up to the apex of the pleural cavity, and another one under the outer reflection of the scapulomuscular flap, and then, by a series of stout, through-and-through sutures, the outer structures were closely united down to the lower confines of the field of operation. The arm was then bandaged to the chest.

Moderate reaction and suppuration followed. The suture line healed by first intention, and by March 24 everything was absolutely dry and firmly healed. Convalescence was much aided by the salutary effect of the patient's stay in the out-door ward of the hospital. He had gained over twenty pounds in weight since the operation and was stronger and more ruddy than ever.

It would be interesting, Dr. Gerster said, to observe what efforts nature would make to liberate the imprisoned lung, to re-form a working pleural cavity and to readjust the thoracic deformity.

URETERAL CALCULUS AND PYELITIS SIMULATING APPENDICITIS.

Dr. Henry H. M. Lyle presented a woman, twenty-six years old, who was sent to the hospital a year ago by a consultant for immediate operation, the diagnosis being acute appendicitis, with which the history and signs apparently agreed. Two points, however, were suspicious: First, the point of tenderness was a little high; and, second, the temperature (105.4°) was rather unusual in acute appendicitis.

On vaginal examination, a stony hard, oval shaped body was detected in the left fornix. Upon further questioning, it was elicited that the patient had had attacks of pain in the left side, and troubled with urination. The latter symptoms had apparently disappeared.

An X-ray, taken the following morning, revealed an oval shaped calculus in the left ureter, just above the bladder, associated with two phleboliths. Upon cystoscopy, the urine from the left ureter was sterile, while that from the right contained epithelial cells, pus and colon bacilli.

The patient refused operation and left the hospital. A year later she returned and requested that the stone be removed, as she was now having considerable pain in her left side. A second X-ray examination revealed the same condition as a year ago. Catheterization of the right ureter showed the urine to be sterile, while that from the left side showed evidences of colon infection.

The ureteral stone was removed through Gibson's extraperitoneal incision, and two phleboliths were removed from the base of the broad ligament.

At the time of this patient's first admission to the hospital, the picture was that of a right pyelitis, closely simulating appendicitis. The finding of the left ureteral stone was accidental, as at that time the stone was giving no symptoms. On her second admission, the picture had entirely changed: it was that of a stone in the left ureter, with superadded colon infection and a clear right kidney. Without the ureteral findings, the pain on the right side would doubtless have been regarded as reflex, and the case would have been classed as one in which the stone was on one side and pain on the other.

BONE TRANSPLANTATION FOR POTT'S DISEASE.

Dr. Lyle presented a man, forty-eight years old, a patient at St. Luke's Hospital, who was suffering from pulmonary tuberculosis and tuberculosis of the sixth and seventh dorsal vertebræ. The history, physical signs and X-ray findings were those of acute Pott's disease.

Operation: A bow-shaped incision was made, extending from the fourth to the tenth dorsal vertebra. The fascia and muscles were separated in mid-line, over the tips of the spinous processes. The spinus processes of the fourth to the ninth dorsal vertebræ were split, and the left half of each turned outward. A bone splint, eight and a half inches long, was removed from the tibia, and after being properly shaped, was placed between the spines of the vertebræ. The fascia and muscles were united over this splint by interrupted kangaroo tendon sutures.

The patient made an uninterrupted recovery, and at present shows an apparent functional and anatomical cure of the spinal lesion. The permanency of this, of course, was problematical, but the operation, in this case, had been of undoubted benefit.

ELBOW MOVABLE AFTER SUPPURATION.

Dr. Robert T. Morris presented a man who had been subjected to some operation for "a tumor near the elbow-joint" two years previously. The nature of the operation could not be determined. The synovial cavity of the right elbow-joint had been suppurating since that time. The patient came to the Post-Graduate Hospital with a phlegmonous inflammation of the arm, and a synovial fistula discharging ropy, purulent synovial fluid. The joint cavity was opened widely and treated with a preparation consisting of 60 parts of camphor, 30 parts of phenol, and 10 parts of alcohol, at the suggestion of a member of the house staff, Dr. Hagmeir. Dr. Morris had anticipated making an excision of the elbow-joint and fixing the arm in the most serviceable position, but under the influence of this application the repair had become complete, leaving a movable elbow, with a range of movement at present extending over forty-five degrees.

PYLORECTOMY FOLLOWING FINNEY'S PYLOROPLASTY.

Dr. Howard Lilienthal presented a man, fifty-five years old, who was operated upon by him by Finney's method in 1908 for a benign stenosis of the pylorus. A good-sized opening was made at the time, sufficiently large to admit three fingers.

The patient returned to Mt. Sinai Hospital in 1912, quite four years after the primary operation, with a recurrence of his symptoms, and much reduced in weight and strength. After a course of palliative treatment, which failed to give him relief, Dr. Lilienthal did a posterior gastro-enterostomy on January 6, 1913. At the same time he took occasion to examine carefully the region of the pylorus, which he found surrounded by a mass of adhesions. The patient was in such a wretched condition at the time that nothing further could be done. Less than a month later, however, he had improved to such an extent that the abdomen was reopened and pylorectomy done. This proved extremely difficult on account of the adhesions. It was interesting to observe the extent to which the Finney pyloroplasty had shrunken, so that it would scarcely admit the end of a probe. The patient made a good recovery. He had regained his natural weight and now felt perfectly well.

In connection with this case, Dr. Lilienthal said he again wished to speak of the advisability of doing these operations in two stages. In this case, the patient could not have withstood the complete operation at one sitting.

Dr. Eugene H. Pool, who was present at the operation in the case shown by Dr. Lilienthal, said the pylorectomy was made unusually difficult by the dense adhesions. It was interesting to note the contraction of the stoma which had been made at the time of the original Finney operation. This, Dr. Pool thought, was rather unusual, and should not militate against the adoption of the method in future cases where it was indicated.

Dr. Gerster said that in doing a pyloroplasty, a large aperture did not insure against its closure. There was no aperture so large that it could not close, and on the other hand, an artificial closure of the pylorus could not be guaranteed to remain closed permanently. This fact was recently demonstrated in a case reported to the Society by Dr. Moschcowitz, where, after resection of the pylorus, followed by closure of both the stomach and duodenum by multiple sutures, communication was re-established between the stomach and duodenum.

In the case shown by Dr. Lilienthal, the speaker said, it was possible that a secondary peptic ulcer developed around the Finney aperture, with the formation of cicatricial tissue and contracture. In establishing a communication between the stomach and jejunum and excluding the duodenum, the surgeon, while he has accomplished something, has not cured the hyperacidity which gave rise to the original ulcers.

DUODENAL KINK.

Dr. Syms presented a woman, twenty-eight years old, who was admitted to the Lebanon Hospital on December 25, 1912.

After several weeks' observation on the medical side of the hospital she was transferred to the surgical service. At this time she was emaciated, weighing but 97 pounds, and highly neurotic; so much so that her case was thought to be one of hysteria. She was depressed, melancholic and emotional, and had been treated in several hospitals in this city without a satisfactory diagnosis having been made and without resulting benefit.

The patient's most obstinate symptom was vomiting, which came on soon after taking food and sometimes after drinking water. There was moderate constipation. While she was in the hospital she vomited two or three times a day and stated that this had been going on for nearly three years. During that time there had been periods of improvement, but there had never been a complete cessation of her trouble.

Examination showed that the woman was poorly nourished and emaciated, presenting the appearance of a patient with enteroptosis and neurasthenia. She had a scaphoid abdomen. There was slight tenderness in the right iliac region, but neither tenderness nor rigidity in the epigastrium. The vomitus contained partly digested food. No blood was found in the vomitus nor in the stools. The X-ray findings were negative and unsatisfactory, and failed to show any evidence of enteroptosis. Examination of the stomach contents showed very little deviation from the normal.

On January 23, 1913, through a right rectus incision, the appendix was found nearly normal, but slightly kinked. There was a pericolic membrane which, however, did not angulate or restrict the colon. This membrane was removed. There was a distinct angulation or kink at about the junction of the first and second portions of the duodenum, which was the result of peritoneal adhesions. These were cut between ligatures, and the angulation thereupon disappeared. There were no evidences of gastric or duodenal ulcer, and no apparent dilatation of the stomach.

The vomiting from which this patient had suffered for three years ceased with the operation, and it had not recurred. Since leaving the hospital, on February 14, 1913, her digestion has been entirely restored, her nervous symptoms have disappeared, and she has gained 24 pounds in weight.

SUPPURATING HYDATID CYSTS OF THE LIVER, SUBPHRENIC SPACE AND PLEURAL CAVITY.

Dr. Parker Syms presented a woman, thirty-three years old, who was admitted to the Lebanon Hospital on November 14, 1910. Her previous history had no bearing on her present condition, which dated back about a month before her admission, when she began to suffer from a dull pain in the back and in the right side of the abdomen. This had gradually become more aggravated, and the patient had rapidly been losing flesh and strength. There was considerable elevation of temperature, with rapid pulse. There was no history of chills. The right lobe of the liver was palpable and tender.

Operation: Through a right rectus incision the liver was exposed. The gall-bladder was shrunken, but otherwise normal in appearance. There was a small nodule at the edge of the right lobe of the liver which was found to contain pus; it was evacuated and packed with gauze. There was also a large mass in the dome of the liver, which was aspirated, evacuating a greenish fluid. Upon incising it, there was removed a large quantity of bile-colored fluid containing pus and hundreds of collapsed daughter cysts.

After this operation, the patient improved temporarily. Then her temperature, which had dropped to normal, again became elevated, with rapid pulse. She lost strength and showed evidence of fluid in the pleural cavity. On April 6, a right intercostal thoracotomy was done, and a quantity of greenish fluid evacuated. About a month later the ninth rib was resected to secure more efficient drainage of the pleural cavity and subphrenic space.

The patient's improvement was slow, but after prolonged drainage she made a complete recovery. She was discharged on June 8, 1911, and has since remained in perfect health.

FRACTURE-DISLOCATION OF THE SHOULDER-JOINT: EXCISION OF THE HEAD OF THE HUMERUS.

Dr. Syms presented a man, twenty-seven years old, who was admitted to the Lebanon Hospital on January 8, 1912, with the history that one week before admission he had slipped and fallen, striking with much force on his right shoulder.

Examination showed a fracture of the upper end of the humerus, with dislocation of the head from the glenoid cavity. This diagnosis was confirmed by X-ray.

Operation, January 17, 1912: After freeing the head of the bone from its attachments and removing it, the shaft was replaced within the capsule of the joint. The capsule was closed as completely as possible, and the superficial wound closed, with drainage. The arm was retained in position with a modified Velpeau dressing. Motion was begun about the fourth week, and the patient was discharged on March 2, 1912.

This patient now had excellent function and was able to use his arm satisfactorily in all normal directions. There was slight limitation of the action of the deltoid, but the patient was able to lift his arm high above his head. There was evidence of some bone re-formation.

Dr. Syms presented also a boy, twenty years old, who was admitted to the Lebanon Hospital on January 1, 1913, with the history that on that day he was thrown from a moving train, striking on his head and right shoulder. Examination showed an avulsion of the scalp from the frontal region backward. There was no evidence of fracture of the skull, but the patient was irrational and violently maniacal for several days, requiring restraint. There was also a fracture of the shoulder-joint, and it was with great difficulty that his arm could be sufficiently immobilized to prevent the fragments of bone from penetrating the soft parts. After a number of days had elapsed, and a satisfactory examination became possible, it was found that he had a fracture of the upper end of the humerus, with dislocation of the head from the glenoid cavity. This diagnosis was confirmed by X-ray.

Attempts at reduction were futile, and the patient was not fit for operation until three weeks after his injury. On January 22, 1913, the joint was exposed anteriorly, going through the split fibres of the deltoid. The head of the bone was found dislocated, with its fractured surface pointing backward and outward. The head was removed with considerable difficulty, and the upper end of the shaft placed in the capsule of the joint. The capsule was then sutured and the superficial wound closed.

The patient made a good recovery and left the hospital on February 23, 1913. He now had very fair function of the arm.

He could move it in all directions, and while he could easily place his hand on top of his head, he could not raise it high above his head, there being a deficiency in the action of the deltoid.

Dr. Gerster asked if there was any reason why the head of the humerus was not saved in the two cases shown by Dr. Syms? There was no compound fracture, and according to the experience of Dr. Murphy, of Chicago, who had published a series of these cases, it might have been worth while to follow his example and liberate the upper fragment and nail it into the glenoid cavity. Even in a case where the head was disconnected, it apparently did not act as a foreign body, providing there was no infection. Dr. Gerster said that personally he had had no experience with this method.

Dr. Syms said that in the two cases he had shown, he had refrained from replacing the head of the humerus after excising it, for the following reasons:

When he operated on the first case he did not feel sufficiently familiar with the method, but was familiar with the good results obtained in these cases by removal of the head of the bone. This fact and his success with the first case prompted him to treat the second case in like manner.

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ORIGINAL MEMOIRS.

TRAUMATIC ERB'S PARALYSIS IN THE ADULT.*

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AND

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THE occurrence of traumatic Erb's paralysis in adults is so frequent and the menace to the future utility of the extremity is so great as to justify a discussion of the subject before this Society.

In all essential features these adult cases are exact counterparts of the brachial birth palsies of Erb's type.

These paralyses are practically always caused by the forcible separation of the shoulder from the head and neck. The more suddenly the force is applied, the more likely are the roots to be torn across instead of simply stretched and frayed. There are many ways in which this separation occurs, but a few illustrations will suffice. One patient fell from the top of a freight car, striking simultaneously upon his head and shoulder with resulting sudden forcible separation of the two. Another, when his bale hook slipped, did a half somersault backward, landing on his head and shoulder. Another was caught in a door which was closing by hydraulic pressure. Another was hit on the shoulder by the long starting lever when a big marine gas engine kicked back. A hundred pound chain after falling two stories struck on the shoulder of an ironworker.

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* Read before the New York Surgical Society, April 23, 1913.

Reference to the anatomical relations of the cervical spine, the shoulder, and the roots of the plexus as they run obliquely across the base of the neck makes it evident that in these forcible separations the strain first comes upon the upper roots of the plexus, then, as they give way, upon the next lower roots, and so on until the entire plexus is ruptured.

Before the nerve-roots themselves give way the deep cervical fascia which lies just in front of them tears, the nerve sheaths rupture, and finally the nerves themselves yield. Combined with these torn fibrous and nerve tissues is the blood-clot resulting from the injured vessels. After a time these elements organize into a cicatrix which prevents the passage of nerve impulses and the regeneration of the nerve fibres.

This cicatrix may involve only a part of the upper root, may involve the entire plexus, or may stop at any point between these two extremes. There may be several cicatrices scattered about the roots.

One or more of the roots may be entirely torn across, the ends dislocated and firmly adherent by cicatricial tissue to neighboring structures. The cicatrices may run well up into the intervertebral foramina, or in certain cases the roots may be torn from the cord itself.

As previously stated, the injury in these cases practically always involves the roots in order from above downward, so that the major effect is in the upper roots and shades off in those below, unless the traumatism has been sufficient to rupture the entire plexus.

The paralyzed muscles fall naturally into groups which correspond with their dependence upon individual nerve-roots for their innervation.

The majority of cases fall into the "upper arm type" in which the fifth and sixth roots are involved. The supra- and infraspinati, the deltoid, the biceps, the brachialis anticus, and the supinators are completely paralyzed, while the pectoralis major is only partly paralyzed because some of its innervation comes from the lower roots of the plexus. There is lost the power of abduction and external rotation at the shoulder, flexion at the elbow, and supination of the forearm, so that the unopposed action of the antagonists causes inward rotation of the arm and pronation of the forearm which gives the characteristic attitude to these paralyzed extremities.

When the injury involves the lower roots there is lost the power to move the wrist, the fingers, and the intrinsic muscles of the hand.

If, as occasionally happens, the damage to the roots occurs close to or within the intervertebral foramina, the nerves running to the serratus magnus, the rhomboids, etc., are injured and wing scapula results.

Occasionally the roots are torn from the cord itself. The resulting superficial scar formation on the surface of the cord may later cause changes in the reflexes or the appearance of the Babinski phenomenon in the corresponding lower extremity.

The muscles which are totally paralyzed become flaccid, show the complete reaction of degeneration (R. D.) (five to seven days), and soon begin to atrophy. Because of such changes in its surrounding muscles the shoulder-joint usually becomes a typical flail-joint.

Other muscles show varying degrees of sluggishness in their reaction to electrical stimuli.

The muscle reflexes are diminished or lost, and there is a decided loss of muscle tone.

Sensory disturbances are less definite and less extensive than the paralyses. The area of sensory disturbances depends somewhat on the extent to which neighboring sound sensory nerves overlap on the field of distribution of the damaged ones. Usually the upper outer region of the arm (the deltoid region) shows the most definite changes. A central area of complete anæsthesia is apt to be surrounded by a border of diminished sensibility which shades off to normal at the periphery.

The areas of disturbance are not co-extensive for the different forms of sensory stimuli (see Figs. 9, 10, 11, and 12).

The sense of deep touch is least apt to be affected. Light touch perception begins to return before that of pain and temperature.

In all of these cases for many months palpation in the region of the sixth cervical transverse process will demonstrate a tender indurated mass which is the cicatrix resulting from the torn deep fascia, nerves, and blood-vessels.

In a certain few cases where the two lower roots are damaged there is an associated injury of the cervical sympathetic (see Case VI).

The course followed by these cases is fairly characteristic. When there has been complete rupture of all the roots there will be permanent paralysis of all the muscles, permanent sensory changes, R. D., marked flaccidity, and atrophy.

When there has been less than complete rupture improvement will always appear after a time, usually three months. In these cases, as the injury occurs from above downward, the lower roots are naturally least injured and therefore show regenerative power first. For this reason the improvement always begins below and progresses upward toward the shoulder. The deltoid and spinati are the last to show results.

Sensory disturbances improve much earlier than do the motor symptoms and may entirely disappear while the extremity is still useless.

Response to the faradic current reappears before much change in the galvanic polarity is noticeable and before voluntary motion is perceptible.

Finally voluntary power reappears in the lowest group of paralyzed muscles, and slowly progresses upward until it has reached the muscle groups innervated by the nerves, which have been so injured that firm cicatrices have formed and prevent nerve regeneration. Here progress ceases. This slowly progressive improvement may cover a period of two years and then the residue of permanent paralysis still be crippling in extent.

The prognosis, without operation, is distinctly bad. In five out of the six cases included in this paper lesions were found which would inevitably have caused permanent paralysis of crippling extent. Nothing short of surgical intervention could have overcome the obstruction to the passage of nerve impulses.

With proper surgical interference the prognosis is immensely improved, but even so, a perfectly functionating extremity can be expected in only a very small percentage of cases.

Certain factors influence the prognosis in any given case:

In general, the longer the time elapsed between the injury and its surgical repair the less perfect will be the regeneration. Nevertheless many cases are on record in which, after years have elapsed, repair has been followed by very satisfactory improvement.

The more extensive the lesion, the less favorable the prognosis, but the more imperative is it to interfere and repair the damage as far as possible.

When the cicatrix extends into the intervertebral foramina the outlook for regeneration is bad and it may be necessary to anastomose the distal trunks into other roots.

When the roots are torn from the cord, anastomosis is the only resource which gives any hope.

Accurate approximation at the time of suture, prolonged immobilization with the shoulder and neck in close proximity, and systematic persistent after-treatment very greatly favor the final success in these cases.

The treatment in all these cases should be surgical. The interference should be at the earliest feasible moment. If the tissues at the base of the neck are much contused, a delay for a few days, in order to increase the local resistance, is desirable. Where the paralysis is very slight conservatism might counsel delay in the hope of obtaining spontaneous recovery, but in all cases where the paralysis is at all marked, the time used waiting for spontaneous recovery is wasted.

In paralysis of slight degree, if operation uncovers no macroscopic lesion of the nerve-roots, the wound is closed and no damage has been done to the patient, for this operation has consisted only in the division of the skin and fat pad at the base of the neck. On the other hand, if some lesion is found, it is corrected at once with the least necessary loss of time to the patient, and at the period most favorable to the regeneration of the nerve-roots involved.

In the third case of the series reported in this paper, while no lesion of the nerve-roots themselves was found, a large indurated mass of tissue lay just in front of them and caused considerable compression. What amounted to a decompression was done, and the result was a very prompt and increasing improvement with a final complete restoration of function in the extremity.

The plexus may be exposed by either of two incisions. One starts just above the insertion of the sternomastoid muscle and passes outward and slightly upward across the base of the neck following the natural wrinkles of the skin. The skin and underlying fat pad are divided in the same line. Usually the external jugular vein, the transversalis colli, and suprascapular vessels are tied and divided. With proper retraction the nerves are pretty well exposed. This wound falls together naturally and heals without any tendency in the scar to spread. Its disadvantage is that in wide-spread damage of the plexus it does not give complete exposure.

The other incision starts at the level of the transverse process of the sixth cervical vertebra and runs obliquely downward and outward to the junction of the outer and middle thirds of the clavicle and divides practically the same structures as in the preceding case (Figs. 1 and 2).

After retraction of the wound in either incision, the deep layer of cervical fascia normally lying just in front of the plexus is found thickened and adherent to the underlying nerves. This is dissected away, thus exposing the roots and plexus which are examined by sight, touch, and, if necessary, by a tiny electrode, to detect the presence of cicatrices which prevent nerve regeneration and the passage of nerve impulses.

The cicatrices are removed by transverse section of the nerves above and below at such levels as expose normal looking nerve bundles in the divided nerve ends. It is sometimes necessary to make several sections before getting a satisfactory looking end. In the distal nerve trunk one can always get a satisfactory looking end by going far enough. In the proximal end, however, the cicatrix sometimes extends up into the intervertebral foramen. These exceptional cases will be considered later.

When the nerves have been properly prepared, end-to-end suture should follow. The best suture material in adults is fine strong silk because it is dependable. On opposite sides of the nerve, about one-half centimetre from its freshened end are passed two sutures transversely to the long axis of the nerve, and including mostly nerve sheath. Each suture is tied so as to get a firm hold and the ends are left long. The other freshened nerve end is treated in similar fashion and the two are approximated by tying the lateral sutures of the one to the other. One or two fine catgut sutures at the periphery will complete the apposition.

Another method of suture which is satisfactory, especially where there is not too much tension, consists in passing a loop of chromic catgut through both nerve ends and tying them together. This is quicker and simpler but has the disadvantage of perforating the nerves as well as not being quite so dependable.

While the nerve sutures are being tied the neck and shoulder are approximated. The fat pad is allowed to fall into place, and the skin wound is sutured with silk. No drainage is used.

The approximation of the neck and shoulder is maintained by means of a steel brace especially designed for these cases and fitted previous to operation so that it can be slipped on just after the nerve sutures have been tied and thus prevent any chance of tearing them out.

This brace is worn continuously, without a moment's intermission, for six to twelve weeks according to the individual case.

In those cases where the cicatrix extends up into the intervertebral foramina, a modified procedure is necessary. The cicatrized root may be split longitudinally up into the foramen, and if good nerve bundles are exposed above, the distal end of the nerve may be sutured into the cleft with the hope that good union will occur. If the split cicatrix does not reveal good bundles above, the only thing left to do is lateral anastomosis of the distal nerve trunk into a neighboring sound root.

In those cases where the roots have been torn from the cord, lateral anastomosis is the only thing to be done.

Where considerable lengths of nerve-roots must be resected to get beyond the cicatrices and the ends cannot be closely approximated, resort must be had to nerve bridging, or the procedure next mentioned.

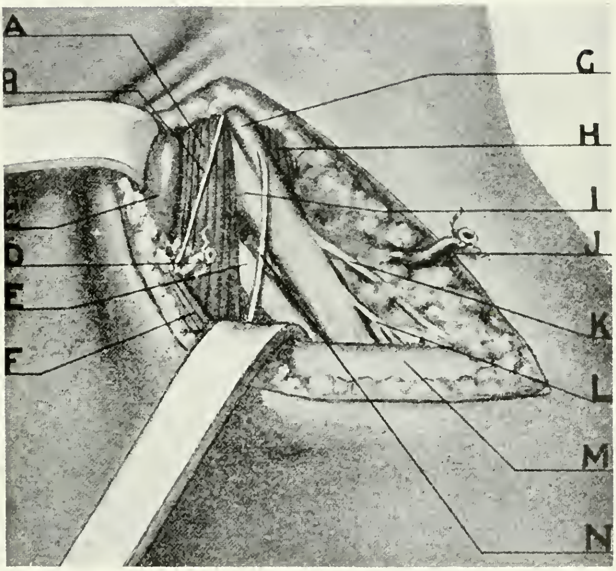
Where the entire plexus is badly torn, and the freshened nerve ends cannot be brought together, a subperiosteal resection of the middle third of the clavicle will permit very greatly increased approximation of the nerve ends. This would greatly increase the chances of regeneration, and certainly an extremity with a damaged clavicle, which will nevertheless move, is very much to be preferred to an anatomically complete extremity which is permanently paralyzed.

When the proper time for the removal of the brace has arrived, the extremity may be placed in an ordinary triangular sling supported by the sound shoulder, and so adjusted as to elevate the paralyzed shoulder. The brace and sling not only prevent the paralyzed extremity from dragging on the nerve suture but also prevent the weight of the extremity from overstretching the paralyzed muscles and thus prolonging their period of inactivity even after nerve repair has occurred.

When the change from brace to sling has been made the extremity may be given massage, passive motion, electricity, etc., every day, being taken from the sling for that purpose. Procedures which would pull the shoulder away from the neck on the operated side should be avoided for many months.

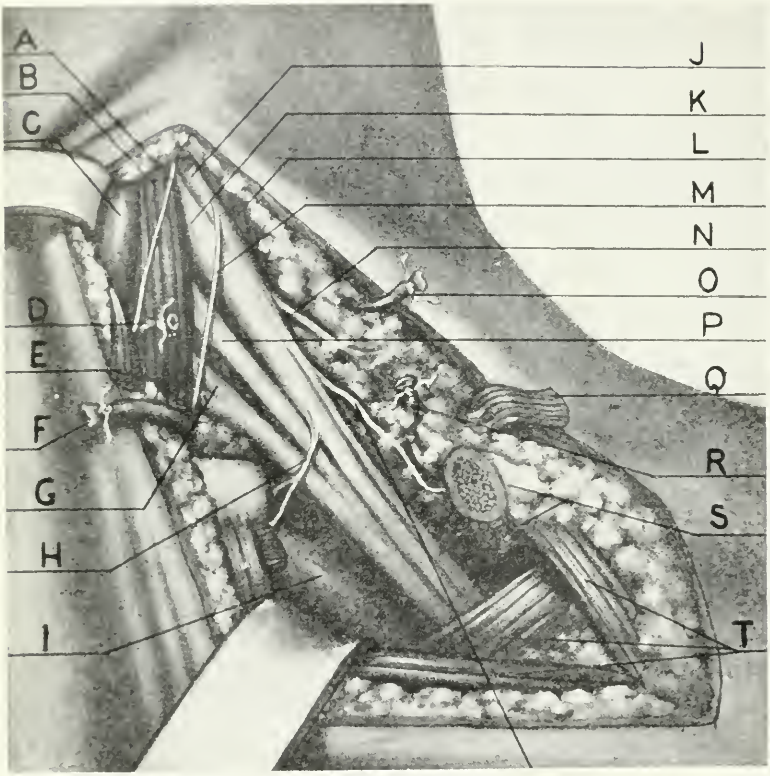
At any time after three months from operation voluntary motion may begin to appear in the paralyzed muscles, and as

FIG. 1.



Operation for relief of brachial paralysis. A, scalenus anticus muscle; B, phrenic nerve; C, internal jugular vein; D, transversalis colli artery; E, seventh root; F, omohyoid muscle; G, fifth root; H, scalenus medius muscle; I, sixth root; J, transversalis colli artery; K, suprascapular nerve; L, external anterior thoracic nerve; M, clavicle; N, nerve to subclavius muscle.

FIG. 2.



Operation for relief of brachial paralysis. A, phrenic nerve; B, scalenus anticus muscle; C, internal jugular vein; D, transversalis colli artery; E, omohyoid muscle; F, suprascapular artery; G, eighth cervical and first dorsal roots; H, muscular branch; I, subclavian vein; J, fifth root; K, sixth root; L, scalenus medius muscle; M, nerve to subclavian muscle N, suprascapular nerve; O, transversalis colli artery, omohyoid muscle; R, suprascapular artery; S, clavicle and subclavius muscle; T, pectoralis major, pectoralis minor, and deltoid muscles; U, anterior thoracic nerve.

Fig. 3.

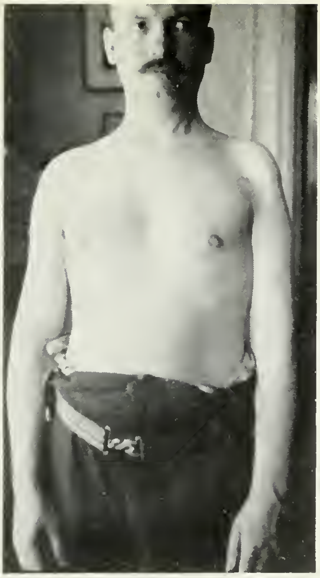


Fig. 4.

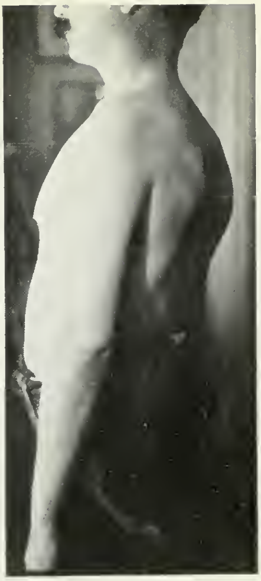
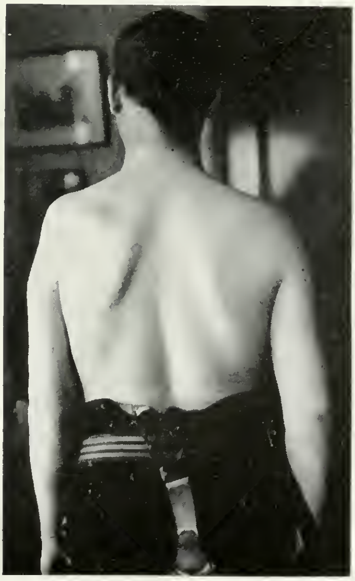
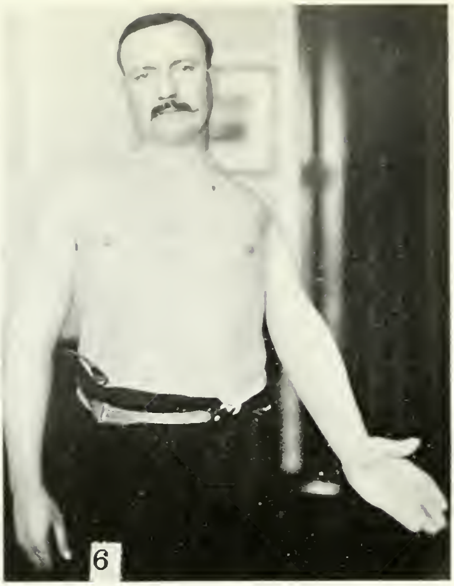


Fig. 5.



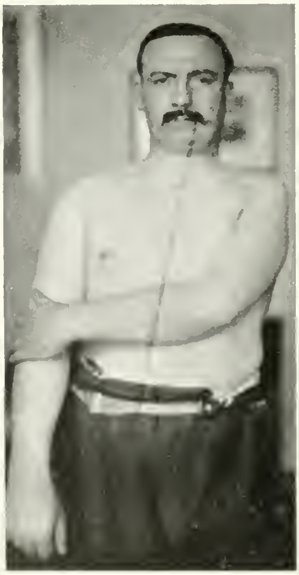
Figs. 3, 4 and 5.—Before operation. Showing flail-joint at shoulder, with marked atrophy of the muscles.

Fig. 6



Six months after operation. Showing slight abduction at shoulder, and slight supination of forearm.

Fig. 7.



Six months after operation. Flexion at elbow sufficient to grasp opposite arm above the elbow.

they regain their tone the sling may be discarded. With the return of voluntary motion the patient should be encouraged to take systematic exercises for the development of the muscles.

Case I.— Patrick B., thirty-five years old (with Dr. T. P. Prout). Six and one-half months before operation, while working, his bale hook slipped and he did a half somersault backward, landing on his head and left shoulder. There was immediate complete paralysis of the left upper extremity, except for some motion in the fingers and wrist.

During the period before operation there had been full return of motion and power in the hand and wrist. He had not been able to use the shoulder muscles nor to flex the elbow.

Physical Examination.—There was some voluntary motion in the pectoralis major. The deltoid and spinati muscles were markedly atrophied, and the shoulder was a flail-joint. The biceps and brachialis anticus were moderately atrophied. They could not flex the elbow, which was held firmly extended by an active triceps. There was no supination of the forearm. Mobility and power of the wrist and fingers was apparently normal (Figs. 3, 4, and 5).

The junction of the fifth and sixth roots on the left side of the neck could be felt as a palpably thickened tender mass.

Operation (June 28, 1905).—Ether anæsthesia. The oblique incision from the posterior border of the sternomastoid muscle at the level of the carotid tubercle down to the junction of the middle and outer third of the clavicle was used. The skin, underlying fat pad, and vessels were divided. The deep cervical fascia was found thickened and adherent to the junction of the fifth and sixth roots, which junction was much enlarged and full of hard cicatricial tissue. The deep fascia was dissected off. The lines of section for the removal of the cicatrized nerve passed through the fifth and sixth roots just before their entrance into the junction, through the suprascapular nerve just after its origin from the junction, and through the distal nerve trunks just after their exit from the junction. The segment removed was about 2 cm. long. End-to-end suture was then done with No. 1 silk as previously described.

Good approximation was gotten without much tension.

The wound was closed without drainage, and the dressings were applied so as to hold the shoulder and head in close approximation. (At this time the steel brace had not been worked out.)

Healing was by primary union. The skin sutures were removed on the fifth day. On the tenth day the patient appeared with the bandages in his pocket and his head moving freely, to "give it a rest" as he said. Although the nerve sutures were probably torn out, he refused further operation but consented to being rebandaged and staying for three weeks in the desired position.

He came very irregularly for after-treatment.

September 28, three months after operation, there was slight evidence of voluntary motion in the biceps, brachialis anticus, and supinator muscles of the forearm.

December 24, six months after operation, there was slight power of abduction at the shoulder, well-developed power of supination of the forearm, and sufficient flexion at the elbow so that he could grasp the opposite arm just above the elbow. He could also reach the water faucet with his left hand and turn on the water (Figs. 6 and 7). He then disappeared from observation.

Case II.—Michael R., thirty years old. Some months before operation he had been thrown off a trolley car, landing on his head and left shoulder. There was complete paralysis of the left upper extremity. The shoulder soon became a flail-joint, to help overcome which the attending doctor had shortened the capsule of the joint.

During the few weeks preceding operation there had been some return of motion in the fingers. All the other muscles were completely paralyzed and considerably atrophied.

There was induration about the fifth, sixth, and seventh roots and the region was markedly tender.

Operation (June 15, 1909).—Ether anæsthesia. The exposure was the same as in Case I. The deep fascia was dissected away and exposed a hard fibrous cord running from the fifth and sixth roots down to a large cicatricial mass under the clavicle. The seventh root also showed fibrous damage. The section ran through the fifth, sixth, and seventh roots near the intervertebral foramina, through the suprascapular just after its origin, and through the nerve trunks just beyond the cicatricial mass.

End-to-end suture was done by means of chromic catgut. Dressings were applied as in Case I.

(This case was done on short notice in a hospital far out of town, and the complete history both before and after operation which were promised have never made their appearance. The typical history of injury and the characteristic findings at operation make it a case in point.)

Case III.—Fritz S., thirty-three years old, mechanic, entered the Neurological Institute, Third Division, on February 10, 1911, with paralysis of the left upper extremity.

He had always been well and doing heavy work.

On January 23, 1911, he was caught by the door of an air chamber in a caisson and jammed in such fashion that his left shoulder was crowded downward while his head was pushed well over on his right shoulder, in other words, his head and left shoulder were slowly, forcibly, and very widely separated. He was confined in this position for forty-five minutes, when he was released in an unconscious condition. On the recovery of consciousness he was found to have dislocation of the right shoulder and complete paralysis of the left upper extremity.

Eleven days later there was slight flexion and extension of the fingers of the left hand. Otherwise there was complete paralysis, but with no restriction of passive motion. There were no definite anæsthesias, but all sensations were somewhat dulled over the area supplied by the fourth to the seventh cervical roots (Fig. 8).

There was moderate atrophy of the left deltoid and scapular muscles. The vasomotor condition was normal, the nutrition was good. R. D. was complete in the deltoid, and partial in the biceps.

Dynamometer test showed L. 0, R. 60.

X-ray plates showed no lesion of the cervical spine.

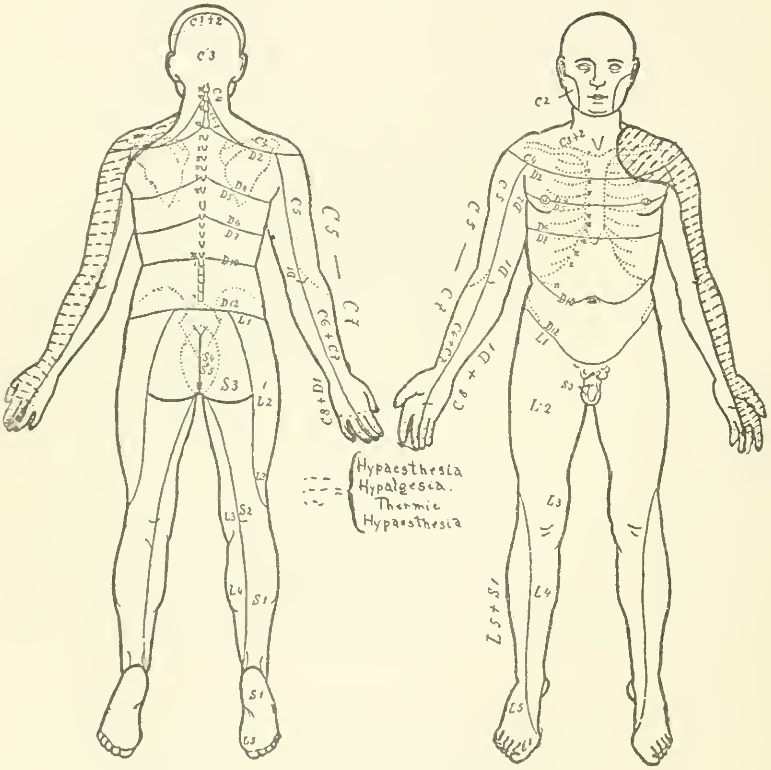
There was no Babinski phenomenon on either side.

February 19, 27 days after injury, there was slight flexion and extension at the elbow and wrist, slight supination and pronation of the forearm, and full range of flexion and extension of the fingers. None of these movements had any power. Dynamometer R. 80, L. 5.

There was very slight sensory improvement. There was no sign of improvement in the shoulder region.

Operation (February 20, 1911).—Ether anæsthesia. The oblique incision previously described was used. The fat and cervical fascia at the base of the neck were very much infiltrated, indurated, and adherent to the front of the plexus roots. This mass of tissue was separated from the plexus and retracted inward. The nerves themselves showed no macroscopic lesions, and were therefore suffering chiefly from the overstretching and from the pressure and adherence of the indurated mass lying in front of them.

Fig. 8.



During the dissection and manipulation much of the infiltrating material escaped from the fatty fibrous tissues so that the mass was much smaller and softer when the wound was closed. No drainage was used.

February 23: Voluntary motions were much more rapid than before operation.

February 25: Healing by primary union. Sutures removed.

February 28: A sling was substituted for the steel brace which had developed one or two uncomfortable pressure points. From this time on massage and interrupted galvanism were used. Special massage was given to remove the induration from the tissues in front of the plexus.

The sensory disturbances gradually disappeared. On March 11, 1911, he was referred to the dispensary for continued treatment.

March 23, 1911: All the muscles except the deltoid are stronger. He is able to raise his hand to his face.

Dynamometer L. 80, R. 115.

The sensory disturbances are gone.

The patient disappeared and was not seen again until December, 1912, when the left arm seemed perfectly normal. The deltoid was completely restored and was so strong that he could support the weight of a man on the outstretched left arm.

There were no signs of atrophy or weakness anywhere in the extremity.

Case IV.—Jas. H., thirty-nine years old, ironworker, came to the Clinic of the Neurological Institute, Third Division, on July 2, 1912, complaining of paralysis and numbness of the right upper extremity. Six weeks before, a hundred pound chain, after falling 75 feet, struck him on the right shoulder. The upper third of the humerus was fractured and a cast was applied. On the removal of the cast four weeks later, there was complete paralysis of the extremity, also numbness of the outer side of the arm. There was no pain.

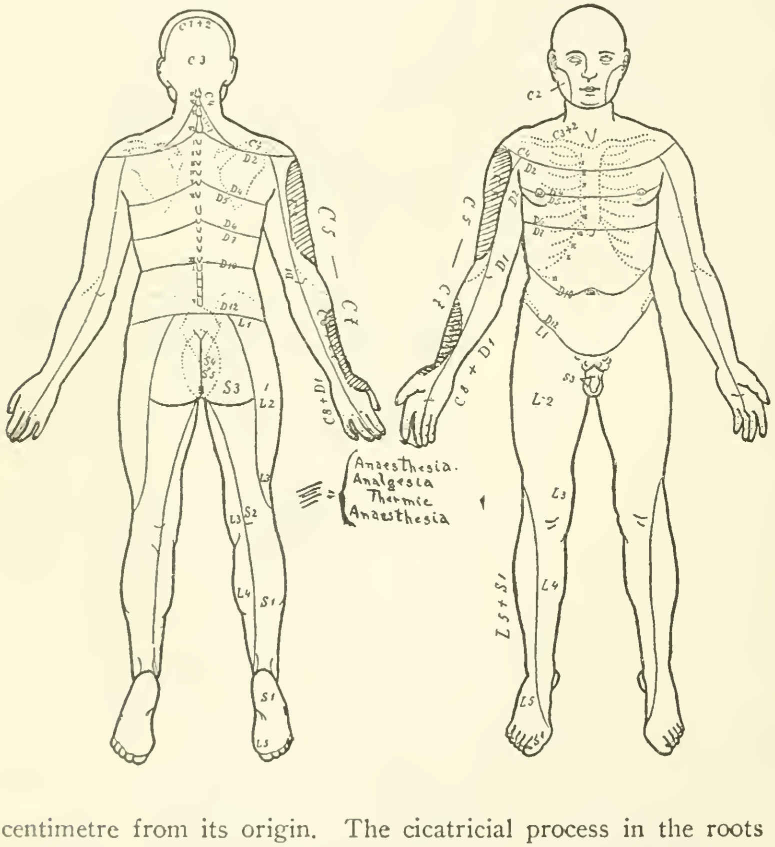
Examination showed complete flaccid paralysis of the right upper extremity with a flail-joint at the shoulder.

Passive motion was perfectly free. The reflexes were lost. R. D. complete in the right deltoid and biceps. There was some anæsthesia of the arm and forearm (Fig. 9). There were no abnormal signs elsewhere.

Systematic treatment with interrupted galvanism having caused no improvement, he entered the hospital, Third Division, on August 27, 1912 (14 weeks after his accident). His condition was unchanged except that atrophy of the deltoid and shoulder girdle muscles of the right side had occurred.

Operation (August 29, 1912).—Ether anæsthesia. The oblique incision was made on the right side of the neck. The lesion was found to involve the fifth and sixth roots and their junction. The suprascapular nerve was cicatrized for about a centimetre from its origin. The cicatricial process in the roots extended to just within the intervertebral foramina. The line of section passed through the roots just external to the foramina, through the distal trunks at their origin from the junction of the two roots, and through the suprascapular just beyond the damaged portion.

Fig. 9.



The two roots were split longitudinally up into the foramina until good nerve bundles were seen. Chromic catgut sutures were passed between the split roots and the distal trunks, including the suprascapular.

When these sutures were tied, the best approximation obtainable still left a gap of 1 cm. between the nerve ends. Cargile membrane was wrapped around the sutures to form a sort of canal. The wound was closed without drainage. The steel brace was applied and was worn steadily for twelve weeks. Good primary union was obtained.

When the brace was removed on November 22, the extremity was very stiff and atrophy, especially around the shoulder, was marked. Sensory symptoms and electrical reactions were the same as before operation.

Active massage and interrupted galvanism were used systematically. In February, 1913, power in the hand was fast returning, there was fairly good flexion at the elbow, but nothing in the deltoid.

April 1, 1913 (seven months after operation), the arm was held close to the body, with the forearm pronated. The elbow could be flexed to a right angle. Supination was not possible.

Abduction at the shoulder to 15 degrees, forward extension to forty-five degrees, and backward extension to normal degree were found.

Dynamometer R. 35 kg., L. 55 kg.

Sensation was improved (see Fig. 10).

Case V (with Dr. Beling).—Roy S. P., age twenty years, had always been in good health up to the time of his injury.

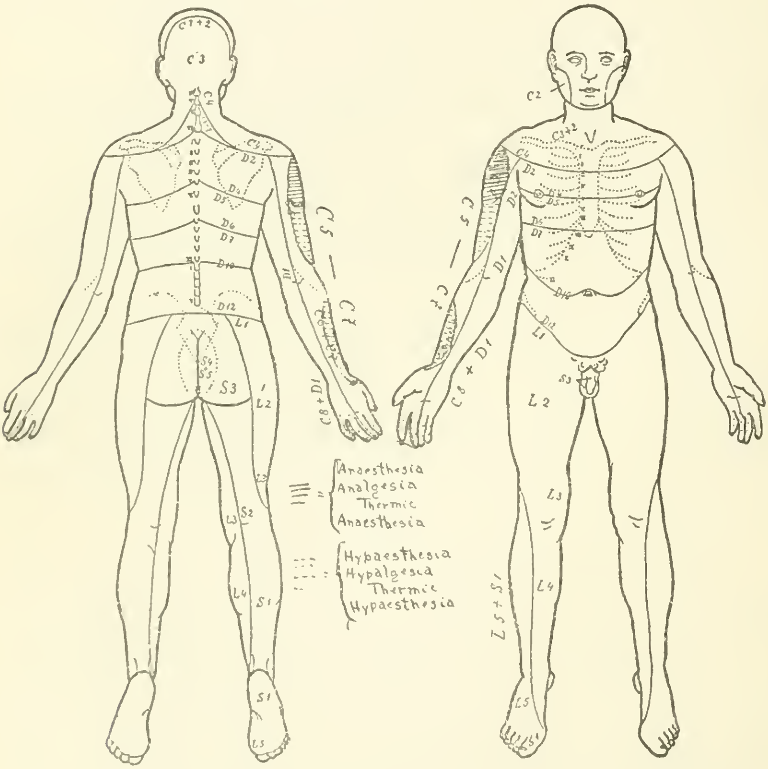
On September 11, 1910, while going 60 miles an hour in a motor-cycle race, he was thrown, landing with his head toward the oncoming machines. As he was scrambling to his feet one of them hit him in the left base of his neck. He was unconscious, the pulse was 150, the left pupil was dilated and did not react to light, while the right pupil was contracted. There was no bleeding from the nose or ears. The sixth and seventh left ribs were broken in the midaxillary line.

For three days there was retention of urine, and for two weeks a low muttering delirium persisted.

Four days after the accident it was noticed that he did not use his left arm.

On September 24 there was a loss of all forms of sensibility over the areas supplied by the seventh and eighth cervical and first dorsal nerves. There was weakness of the triceps, extensors of the wrist and fingers, pronators, pectoralis major, and latissimus dorsi; paralysis of all the flexors of the wrist and fingers, of the thenar and hypothenar eminences, and of the interossei.

Fig. 10.



The sensory symptoms referable to the middle trunk gradually cleared up.

On September 30, a radiograph showed a fracture of the left transverse process of the seventh cervical vertebra with the fragment lying over the region of the eighth cervical and first dorsal roots. At this time he was complaining of severe cramps in the flexors of the forearm.

On October 2, 1910, the left knee-jerk was a little more lively than the right. There was no Babinski and no ankle clonus on either side.

The persistent symptoms were characteristic of the lower arm type of brachial paralysis (Klumpke type). There were associated symptoms of paralysis of the sympathetic, evidenced by homolateral pseudoptosis, myosis, enophthalmus, and an absence of the ciliospinal reflex.

The cramps were very troublesome. They were believed to result largely from irritation caused by the movable fragment of transverse process previously mentioned, inasmuch as they were greatly aggravated by such movements as caused muscular pull on the fragment. It therefore seemed advisable to explore the plexus and to remove the fragment.

Operation (November 1, 1910).—Ether anæsthesia. The oblique incision was used for the exposure of the plexus. The loose fragment of bone was found to consist of the anterior half of the left transverse process of the seventh cervical vertebra, and was displaced downward, pressing somewhat upon the eighth nerve-root. This fragment was removed. Examination of the roots of the plexus showed no macroscopic evidence of damage, so the wound was closed and the extremity placed in a brace to prevent the drag of the paralyzed extremity on the nerve-roots.

After three weeks the brace was replaced by a sling and the extremity was given massage and electricity at the irregular times that he appeared for treatment.

There was a gradual return of power in the muscle groups supplied by the fifth, sixth, and seventh roots. The cramps were diminished in frequency and severity but did not entirely disappear.

After 28 months there had been no improvement in the muscles supplied by the eighth cervical and first dorsal; on the contrary they had undergone marked atrophy. Remembering that these roots, at the time of the operation, had shown no macroscopic evidences of injury, it seemed, from the persistent paralysis, that they must have been torn from the cord at the time of the original accident, and that the only thing left to do was to transplant them to some of the other roots.

On January 19, 1913, Dr. Beling made the following notes:

Circumference.	Right.	Left.
Mid-arm	9¾ inches	8¼ inches
Below elbow	9⅝ inches	8½ inches
Wrist	6¼ inches	5⅞ inches

The triceps was weak with partial R. D. Biceps in good condition. Deltoid in fairly good condition. The lower portion of the pectoralis major was atrophied, the upper portion in good condition. Pectoralis minor rather weak.

The muscles supplied by the eighth cervical and first dorsal were markedly atrophied, completely paralyzed, and showed complete R. D. Left wrist-jerk was absent.

There was no Babinski phenomenon and no ankle clonus on either side.

The knee-jerks were about equal and normal.

Operation (January 20, 1913).—Ether anæsthesia. The two lowest roots of the left plexus were exposed by the transverse incision. They showed no cicatrices within their sheaths and were not adherent to the surrounding structures. They were easily isolated. They seemed somewhat softer than normal roots. On cross section at their exit from the foramina they showed considerable yellowish, fatty substance within their sheaths and the nerve bundles were not nearly so definitely arranged and visible as in normal roots.

The two roots together were implanted into a longitudinal slit in the side of the junction of the fifth and sixth roots, with fine chromic gut sutures. The seventh root was none too good at innervating its own group of muscles, so was not considered for the grafting process.

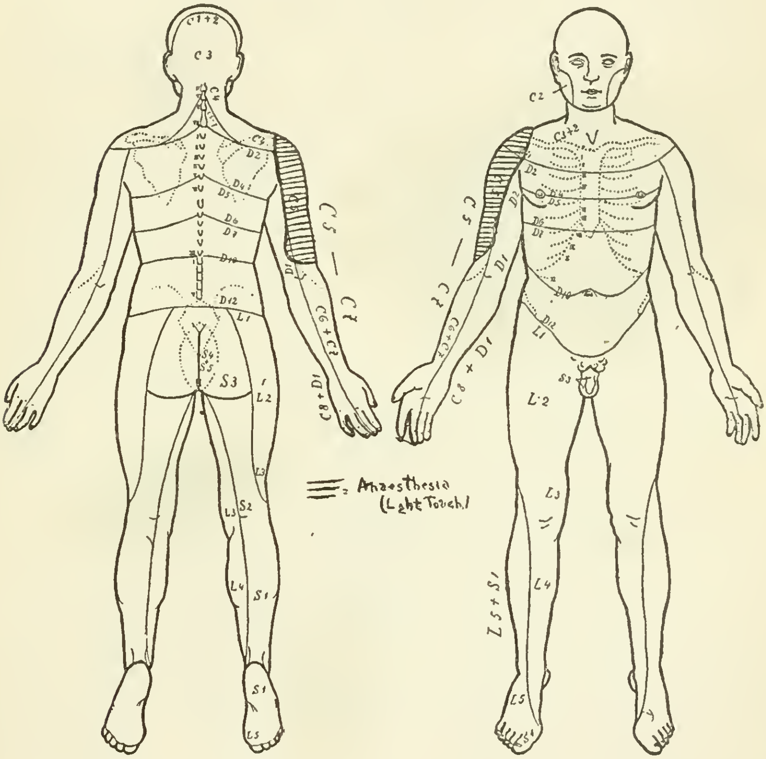
The wound was closed without drainage and the extremity put up in a sling, which was worn for three weeks.

Sufficient time has not elapsed for results to have appeared.

Case VI.—Jeanne G., forty years old, was admitted to the Third Division of the Neurological Institute on January 21, 1913, with paralysis of the right upper extremity. About five weeks before, she had fallen backward out of a window about five feet to the ground, striking first on the left hand and sustaining a Colles fracture, then rotating so that her right shoulder and head struck. The right upper extremity was paralyzed.

Physical Examination.—It was seen on admission that motions of the wrist and hand were fairly well preserved, but that elsewhere in the extremity there was complete flaccid paralysis. Passive motion was unobstructed. The reflexes were abolished in the right upper extremity, but were normal everywhere else in the body.

FIG. 11.



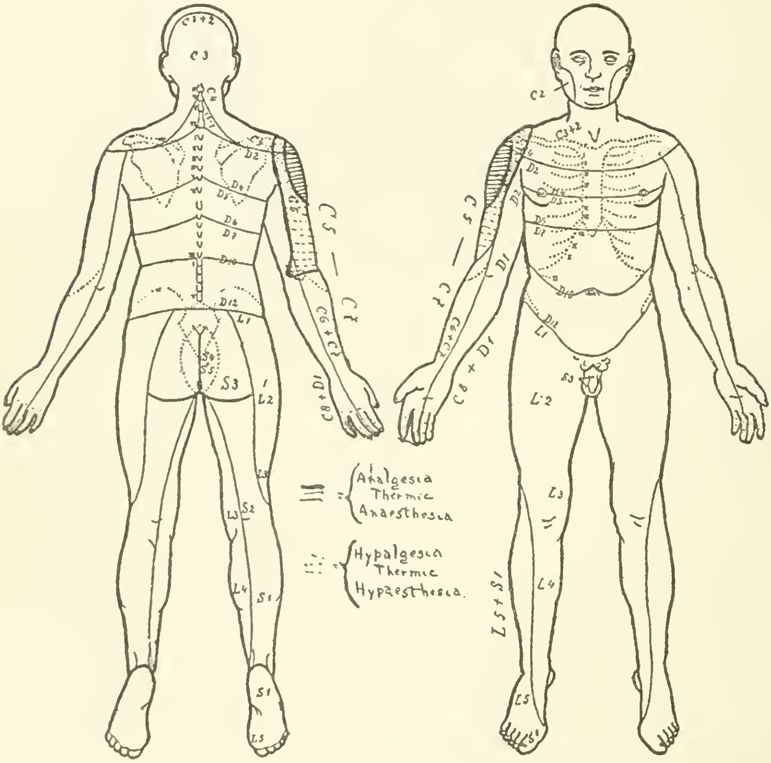
There were no apparent muscle atrophies, but the muscle tone in the deltoid, biceps, and triceps muscles was much diminished.

R. D. was present in the deltoid and much diminished excitability in the biceps and pectoralis major.

There was anæsthesia to light touch over the area of the right fifth cervical root. To pain and thermal stimuli the area of anæsthesia was smaller but was surrounded by an area of hypalgesia coincident with the distribution of the fifth root (Figs. 11 and 12).

Operation (January 21, 1913).—Ether anæsthesia. The transverse incision previously described was used in this case. The fat pad was divided in the same line, exposing the damaged deep cervical fascia adherent to the plexus. When this was dissected away it was found that the fifth root had been completely ruptured just above its junction with the sixth, the sixth root had been almost torn across but was still connected by a cicatricial band about 2 cm. long with the junction of the fifth and sixth roots, which had been displaced toward the clavicle about that distance. The seventh and eighth roots appeared undamaged.

FIG. 12.



The line of section went through the fifth and sixth roots about 0.5 cm. external to the foramina, through the junction of the two near its distal end, and through the suprascapular near its origin. Silk sutures were used and complete approximation of the nerve ends obtained. The wound was closed without drainage and the brace applied.

Primary union was obtained. The brace is still on.

COMMENT.

The series of cases reported in this paper has given results that are so far by no means brilliant. The last half of the series is still in process and no one can tell what the final results will be.

In five out of the six, lesions were found that precluded anything like satisfactory spontaneous recovery.

In the first case, in spite of his removing the restraining dressings and probably rupturing the nerve sutures, the patient regained some power in muscles innervated by the roots from which the cicatrix had been excised, showing that some regeneration had occurred even under most adverse circumstances.

In Case II no post-operative information has ever been obtainable, but a lesion was exposed and removed which would have caused permanent paralysis in the muscles supplied by the fifth, sixth, and part of the seventh roots.

In the third case, while there was no macroscopic lesion of the roots, there was distinct interference with nerve function caused by the densely infiltrated tissues of the base of the neck, which were firmly adherent to the front of the roots. The operation not only loosened up this adherent material, but gave precise information upon which to base the treatment which led to steady improvement and final complete recovery.

In the fourth case there seemed, at the time of operation, very little hope for a good result. The cicatricial tissue extended up into the foramina in both the fifth and sixth roots so that they had to be split longitudinally to expose good fibres; the cicatrix was extensive and required free excision; the suture could not bring the distal trunks nearer than 1 cm. to the damaged root stumps. In spite of these handicaps, at the end of seven months from operation, the patient is showing decided signs of nerve regeneration and returning muscular power.

In the fifth case, where the two lowest roots were probably torn from the cord, the transplantation has been done too recently to afford any evidence of nerve regeneration.

The sixth of the series ought to give a very good result. The patient was operated upon five weeks after the accident, the nerves above and below the cicatrix were good, and the approximation by suture was nearly perfect. We shall hope to show this case when sufficient time has elapsed for recovery to have occurred.

These plexus injuries are by no means rare, and yet there is no well-settled system of management of them which is generally recognized by the surgical side of the profession. This fact is illustrated by the following two instances which have come within our knowledge: A young man fell from a freight car, landed on his head and left shoulder, and suffered complete paralysis of the left upper extremity. Six weeks later he was sent into one of the large general hospitals of this city. Exploration showed complete rupture of the plexus with wide-spread formation of scar tissue. The wound was closed with no attempt at repair, the man was told never to let any one attempt to do anything with the plexus, by another operation, and he was turned loose with the flail extremity unsupported and dragging on the plexus and muscles so that any chance of partial spontaneous regeneration was lost. In this case resection of the cicatrized plexus together with resection of the middle part of the clavicle would have allowed sufficient approximation of the nerve ends to have given some chance of regeneration and later usefulness.

In the other case a man had his left plexus completely ruptured by the kick back of the starting lever of a big marine engine. He was taken to a well-known hospital, not in New York City. The day after injury the plexus was explored but no attempt at repair was made. On the fourth day, for some unexplained reason, the extremity was amputated at the shoulder.

These two cases indicate the necessity of bringing the subject forward for discussion.

SUMMARY.

Traumatic Erb's paralysis in the adult is by no means rare.

The cause is practically always a forcible wide separation of the head and neck from the corresponding shoulder.

The resulting lesion consists of torn deep cervical fascia, torn nerve sheaths, torn nerve fibres, torn vessels with resulting blood-clot. All of these elements combined form a cicatrix or cicatrices which interfere with nerve regeneration and function.

In nearly all cases the injury involves the roots in order from above downward, and the maximum injury is to the upper roots.

The roots may be torn from the cord, although fortunately this is not so very common. The cicatrices in the other cases may be small, large, single, or multiple, and may be located anywhere from within the intervertebral foramina out to the distributing trunks which arise from the plexus.

The symptoms depend upon the situation of the cicatrices and the number of roots involved. The paralyzed muscles fall into groups which correspond with the plexus roots from which they derive their innervation. The sensory symptoms are neither so definite nor so wide-spread as the motor, and they are apt to disappear much sooner. The completely paralyzed muscles show R. D., while the less completely paralyzed ones show various degrees of sluggishness to the testing currents. The lesion can always be felt through the skin by the examining finger.

The prognosis, where there is a real lesion, is distinctly bad without operative repair. With prompt operative repair the outlook is much improved, but a really perfect result is not to be attained in many cases.

The only rational treatment consists in prompt exploration with such repair of nerve structures as may be indicated in the individual case. If no macroscopic injury is found, practically nothing but a skin wound has been made. After the few days required for healing, the after treatment may be started vigorously and with exact knowledge of the condition to be dealt with. If gross injury is found it can be repaired at once and so cause the least loss of time to the patient, and give the most favorable opportunity to the nerves for complete repair.

Operation consists in the resection of the damaged areas of nerve, followed by end-to-end suture of the roots and trunks.

In bad cases where the resection has been so extensive that approximation by suture is impossible, resection of the middle of the clavicle will greatly facilitate the approximation. An extremity that will move, even with the clavicle absent or distorted, is very much to be preferred to one that is paralyzed but with the clavicle intact.

After-treatment consists in the wearing of some fixation apparatus for from six to twelve weeks, which shall keep the neck and shoulder of the damaged side in close approximation to favor firm anatomical and physiological union of the nerves. With the removal of the fixation apparatus the various forms of physical therapeutics should be systematically employed.

Results are late in appearing and will seldom be perfect.

SPLENIC ANÆMIA, WITH SPECIAL REFERENCE TO ETIOLOGY AND SURGICAL TREATMENT.*

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SPLENIC anæmia, although recognized as a pathologic entity even in the early years of the nineteenth century, presents to-day many unsolved problems. This condition has been described under various names during the past twenty-five years but at the present time splenic anæmia is the generally accepted term. By it we mean a disease of long duration, generally lasting several years, characterized by an anæmia of the chlorotic type, considerable enlargement of the spleen without known cause, an absence of leucocystosis and a tendency to gastro-intestinal hemorrhage. In the advanced stage, cirrhosis of the liver, ascites and jaundice are also present. Banti, Osler and others have fully described the course of the disease and divide it into three distinct stages.

The first stage lasts two to ten years, with splenomegaly, anæmia, gastro-intestinal hemorrhage and pigmentation of the skin as its prominent symptoms. The second stage lasting only a few months adds to these symptoms kidney insufficiency with scanty high-colored urine. The third and terminal period presents the stage of liver involvement in which appears a cirrhosis of the Lænnec type with its accompanying ascites.

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* Read before the Philadelphia Academy of Surgery, May, 5, 1913.

The name, Banti's disease, has been applied incorrectly to all three stages but it is the symptom-complex of the ascitic stage alone that should bear the name of the man who did so much to clear up its symptomatology and pathology.

During the first stage, there are usually marked fluctuations in the severity of the symptoms. Months may pass in which slight enlargement of the spleen is the only demonstrable lesion. Again during the exacerbations, the spleen may enlarge enormously, with coincident increase in the anæmia and icterus.

Etiology.—The etiology of splenic anæmia has proved baffling. Much confusion has arisen and the main purpose befogged in endless discussion as to whether or not the splenomegaly is primary or secondary. The mere fact that we have first this splenomegaly is important, but not necessarily convincing that it alone is responsible for the anæmia, the cirrhosis and endophlebitis of the splenic and portal veins. Rather would it seem more reasonable to us that the splenomegaly was a link in the chain which resulted from the chronic irritation of some as yet unknown toxin, probably of gastro-intestinal origin. Having once acquired splenomegaly, we believe that it is responsible for the anæmia by reason of an exaggeration of its normal hæmolytic functions. In other words, the spleen finds itself much in the same position as the thyroid, which, as the result of some irritation, increases its activity and thus brings about hyperthyroidism. It is logical to assume this because we know that splenectomy, if done in the first stage, stops the anæmia with an early return of the blood picture to normal. Here again, comparison with the results of partial thyroidectomy are apt, since there too an excessive physiological function is checked. But we do not have to depend on splenectomy alone to feel sure this is so. Banti in his latest paper states that the anæmia is due to increased hæmolysis chiefly, and secondly to an actual increase in the blood destroying units of the spleen.

Banti, Joannovico, Lemarre and Gaucher have shown that splenectomized dogs have an increased resistance to certain hæmolytic poisons (pyridine, etc.). F. Bartazzi has also shown increase in the red blood corpuscle resistance in splenectomized dogs. Pagliesi and Tuzzati, later Charrin and Moussie, and later still Gaucher, have shown that splenectomized dogs have a considerable lessening of biliary secretion. The logical conclusion is that the spleen has a great influence on hæmolytic and bilogenic processes not only because it diminishes red cell resistance and prepares them for destruction in other organs, but because it destroys them directly and forms thereby the necessary substances for biliary secretion.

The part that the enlarged spleen plays in the production of the anæmia has given rise to other theories. Harris and Hertzog believe that by reason of an erythrolytic enzyme secreted by the endothelial cells of the hyperplastic spleen there is a destruction of red blood corpuscles, and cite splenectomy with its cure to substantiate them in their position. Barr thinks that an increased blood supply to the spleen, with its consequent fibrosis, causes increased hæmolysis. The congestion is explained on a theory of vasomotor paresis of the splanchnic area from disease of the visceral sympathetic ganglia. Lintvarev believes that the anæmia is due to an increased destruction of the red cells by the erythrophages of the spleen, which cells have been produced in excessive numbers because of certain poisons (exogenous as well as endogenous). Rolleston would explain the anæmia upon an inhibition of blood formation due to the endothelial hyperplasia found in the enlarged spleen. So, while opinions differ as to the actual manner of accomplishment, it seems reasonably certain that the spleen causes the anæmia. Banti's theory of increased hæmolysis brought about by lessened resistance of the red blood corpuscles so that they are destroyed in greater proportion in the liver, lymph nodes and spleen itself, seems to us the most satisfying, since it is based on reliable experimental evidence and clinical findings. In these cases we have icterus without decoloration of the fæces, and we find that in periods of aggravation of the disease a further diminution of the red blood corpuscles and hæmoglobin is coincident with augmentation of icterus and urobilinuria.

The question of the primary intoxication is by no means so definitely settled. Senator was perhaps the first to suggest that the toxin was absorbed from the gastro-intestinal tract. Others have followed accepting this theory, some offering clinical data to substantiate their position. Ostrowski, who states that in ten cases of splenic anæmia in children all had had an antecedent diarrhœa, and Ungar and Neuberg believe that the gastro-intestinal tract must be looked into. It would seem not illogical to assume that the gastro-intestinal tract might furnish the toxin because of the somewhat similar clinical picture that is found in protracted auto-intoxication and in the beginning of splenic anæmia. Banti, however, adhering to the infectious theory, does not believe that the irritant comes from the gastro-intestinal tract, reasoning that the atrophy occurring in the liver from cirrhosis due to auto-intoxication is not produced for years, whereas that occurring in the liver during the third stage of splenic anæmia occurs in a few months. Conflicting ideas also are advanced as to casual relation existing between splenic anæmia and certain diseases, as tuberculosis, syphilis, Kala-Azar, malaria and gout. Banti again thinks that his syndrome, when occurring as the third stage of splenic anæmia at least, is a disease *sui generis,* but does not deny that enlarged spleen, cirrhosis and ascites may be found in the terminal stages of other diseases, as is pointed out by Hultgen, Rolleston and others. Osler thinks that when secondary anæmia and splenomegaly are found in other conditions the differential diagnosis may be made, since (*a*) the cause is usually apparent as malaria, tuberculosis, syphilis, etc., (*b*) the anæmia and splenomegaly usually yield to appropriate treatment, (*c*) the spleen is not so large, (*d*) sequences not so characteristic, (*e*) the blood, while showing secondary anæmia, does not usually show the exaggerated chlorotic type, and (*f*) leucocytosis is more common than leucopænia.

We know that the spleen is not rigidly controlled by nervous influences from the central or sympathetic nervous system, but that its stimulation depends largely upon the circulation of systemic blood which comes in direct contact with the parenchyma of this organ. Further, that a part of its physiologic function is to sift out from the circulating blood bacteria, toxins and other detritus. These facts offer additional theoretical evidence of the probable toxic nature of the primary irritant.

Certainly one of the most interesting problems to be solved is the connection between endophlebitis of the portal and splenic veins and the enlarged spleen. Is the thrombosis primary or secondary? That some relation exists is reasonably certain, because of the frequency with which thrombosis of the portal and splenic is found at autopsy in cases dying of splenic anæmia. The reports of Dock and Warthin, Oettinger and Fiessinger, Banti, Rolleston and many others amply attest this fact.

It was really to attempt to shed additional light on this phase of the question that led the authors to carry out experiments on animals.[1] Our aim was first to produce thrombosis of the portal and splenic and later to study the splenic changes and blood picture. It seemed easy to ligate the splenic vein and cause a passive congestion of the spleen which would, in a measure, at least reproduce what actually occurred in cases of portal and splenic thrombosis. This we did in seven dogs, and found that in every case the immediate enlargement of the spleen was enormous, but in none of our cases did this increase in splenic dimensions last longer than one month, to be followed by permanent atrophy of the organ. The results coincide with Warthin's earlier ligations of the splenic vein. In another series of three dogs and two rabbits ligation of the splenic veins and injection of aleuronat directly into the splenic pulp were tried. Here again, in every instance, temporary increase in the size of the spleen followed with local necrosis of the splenic pulp at the injection sites. The splenic congestion with its consequent enlargement gave way to permanent atrophy. The aleuronat was used to supply an irritant and was chosen because we wished to produce an inflammation that would stop short of pus formation. Feeling that ligation, with its sudden congestion, did not reproduce the actual pathological condition, we attempted partially to occlude the lumen of the splenic vein. This we did by metal clips and loosely tied ligatures in a series of three dogs. Slight enlargement of the spleen occurred temporarily, to be followed in three weeks by a return to the normal size. Having failed with the splenic we next tried, in a series of five dogs, to produce portal thrombosis by exposing the vein, breaking the intima by compression and partially occluding the lumen by means of a silver wire passed around the vein, so as to constrict, but not totally obstruct it. In no case were we able to produce by this means portal thrombosis, although slight temporary enlargements of the spleen were again noticed to measurements.

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[1] All experimental work on animals done under ether anæsthesia.

The pathological studies of the removed spleen following ligation showed passive congestion in the early cases, that is, those removed not later than one month after operation, but no real hyperplasia of the splenic substance. In the later cases, those removed after one month or longer had elapsed, there was atrophy of the splenic pulp and an increase in connective tissue. The blood pictures during the period of splenic enlargement showed no characteristic change beyond a leucocytosis following operation, which returned to the normal after an average period of two weeks had elapsed.

Other experimental work has been done; thus Solowieff produced a fibroid condition of the liver by producing occlusion of the portal branches in dogs. Osler cites a case of his own, however, in which there was obliteration of the portal but no true cirrhosis, although the liver was atrophied and had undergone fatty degeneration to some extent. This case showed enormous enlargement of the spleen with the thrombosis of some of the splenic veins and with that of Cruveilhier, shows that obliteration of the portal can take place in man without cirrhosis of the liver. Banti reports the results of an extensive bacteriological study. Believing that the disease is bacterial in origin, he cultured the peripheral blood, splenic substance, blood of splenic vein and bone marrow in fatal cases without result. Aërobic and anaërobic cultures were both negative. In addition, guinea pigs, rabbits, dogs and rats were injected with the blood, splenic juice, liver and bone marrow without result. Fragments of spleen, liver and bone marrow have been directly injected under skin and into the peritoneal cavity still without infection. Finally Banti grafted pieces of the diseased spleen into the normal spleen of dogs, also without result. He states that similar bacteriological studies by others have always yielded negative findings. Although these experiments have been thoroughly carried out the parasitic origin of the disease has by no means been disproved. The cellular hyperplasia of the spleen in this condition is suggestive of an irritation due to bacterial or at least protozoal growth. Again, in the diseases most closely simulating splenic anæmia, such as tuberculosis and syphilis of the spleen, malaria, etc, specific organisms have been isolated.

Pathology.—Many observers have carefully studied the pathology of splenic anæmia. In the main they agree as to the macroscopic and microscopic picture of the disease. In brief, the essential pathology is first an anæmia of the chlorotic type, the microscope showing marked aniso- and pœcilocytosis, polychromatophilia and often basophilic degeneration of the red cells, with the occasional finding of normoblasts and myelocytes. Secondly, an enlargement of the spleen which weighs on an average 61 ounces. It retains its normal shape, is dense and firm and under the microscope shows a general fibrosis, especially of the malpighian bodies, which are sclerosed and atrophied and often show hyaline degeneration. In addition, the blood spaces show marked hyperplasia of the endothelial cells and many large phagocytic cells, spoken of by Lintvarev as macrophages. In the third stage the liver shows a varying degree of atrophic interlobular cirrhosis, closely corresponding to that seen in chronic alcoholism. In addition, in a large majority of cases, there is reported an obliterating thrombophlebitis in various stages of degeneration of the splenic and portal veins, which often show almost complete obliteration of the lumen.

Treatment.—In the treatment of splenic anæmia, as in its etiology, a great diversity of opinions is met with. Medicine and surgery have had their advocates and opponents. With the rapid advance of surgical technic in the past few decades, the operative treatment now offers the greatest chance for permanent recovery.

In the medical treatment, iron and arsenic stand preeminent. They are of undoubted value in combating the anæmia and in improving the general condition, but at the best they are only temporary aids and in no way counteract the causal factor. Up to the present time literature shows no cases of permanent cure by medical treatment alone.

As our knowledge of the etiology of this condition advances, the medical treatment will of a certainty become more valuable, especially in the early stages. If we can but discover the primary intoxicant and attack this before the spleen is permanently damaged, our therapeutic agents will become powerful factors in what may be called the prophylactic treatment of splenic anæmia. At the present time, the early eradication of any chronic source of intoxication, especially of the alimentary tract, must be of general if not of specific benefit to the patient. As an example, a case of one of the authors may be cited.

A man, forty-six years of age, suffering from mild anæmia of two years' duration, with its usual symptoms and with a spleen reaching to the level of the umbilicus, was examined early in the year. His past history was negative with the exception of occasional attacks of gastro-enteritis and chronic nasal catarrh. An examination showed chronic frontal sinus trouble and marked gingivitis with symptoms of gastric and intestinal stasis. After several months of treatment for these conditions there has been a decided improvement as to the blood and spleen, and marked betterment of the patient's subjective symptoms. The case has been under observation for too short a time to definitely decide whether the improvement is to be more than temporary.

The intravenous injection of salvarsan has been used for this condition and its results parallel those of internal medication, *i.e.,* improvement in symptoms without permanent recovery.

Treatment by X-ray has been tried at various times. Lucatello reports a marked improvement in general condition in the blood and in the spleen for a time, but the relief from this, as from medicine, is only temporary.

In taking up the surgical treatment it may be wise to review the topography of the spleen. We are dealing with an organ of the upper abdomen, lying well within the vault of the diaphragm and overlaid anteriorly by the fundus of the stomach and posteriorly by the ribs. It is securely held in place by its ligaments and in the disease under discussion is often additionally fastened to the surrounding organs and parietes by firm adhesions. Its blood-vessels are large and extremely thin-walled, making ligation a serious matter. The splenic pulp is brittle and tears and bleeds easily under rough handling.

With these points in mind, the difficulties of operative procedures can readily be estimated. Proper exposure is the first essential. Mayo, Meyer, Treves and others have suggested various methods of approach, all of which have many points of merit. We would like to call special attention to a modification of the incision described by Dr. Edward Martin for exposure of the liver and which, in the dissecting room

Fig. 1.

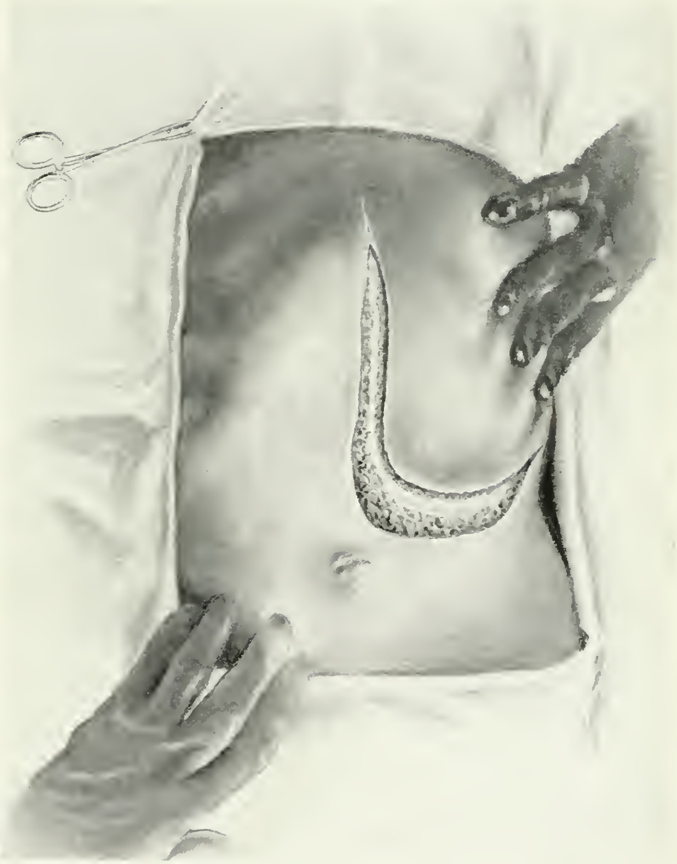


FIG. 2.

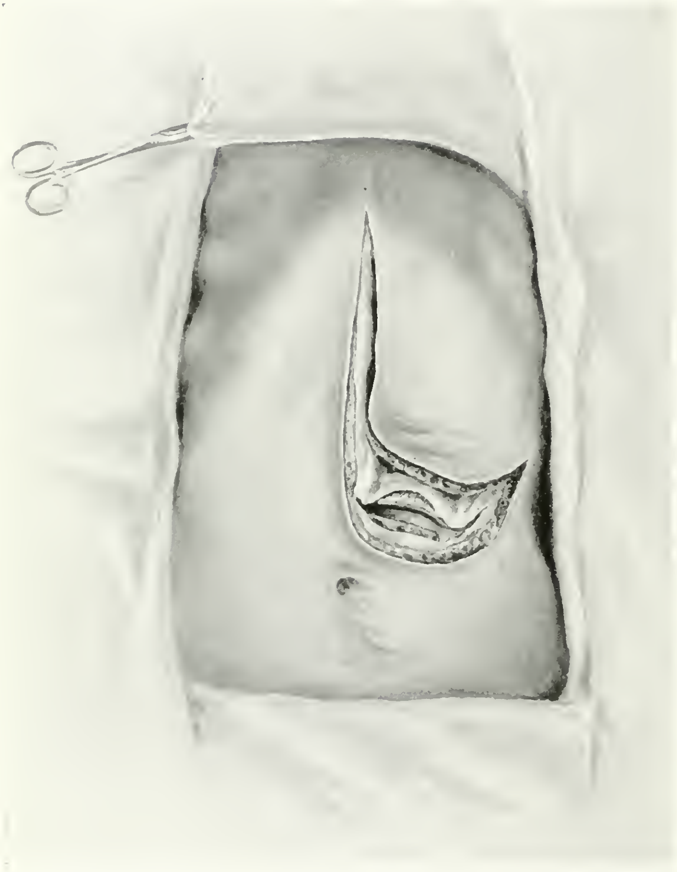


FIG. 3.

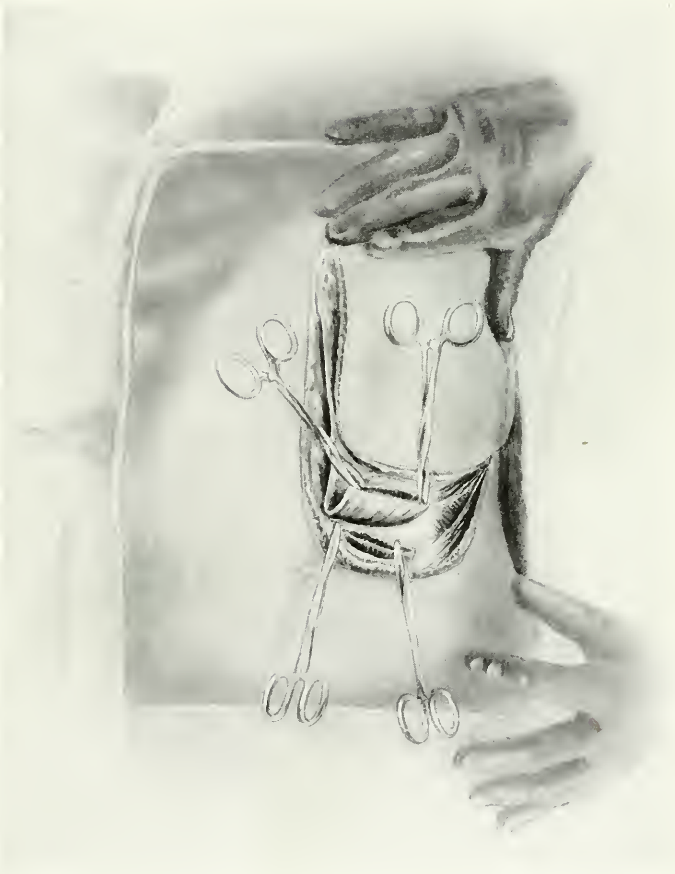


Fig. 4.

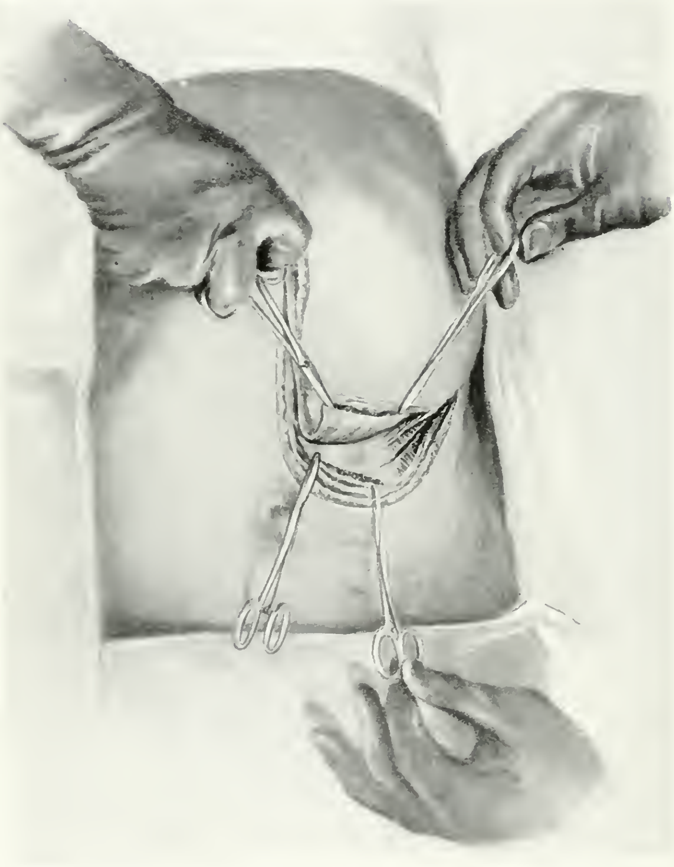
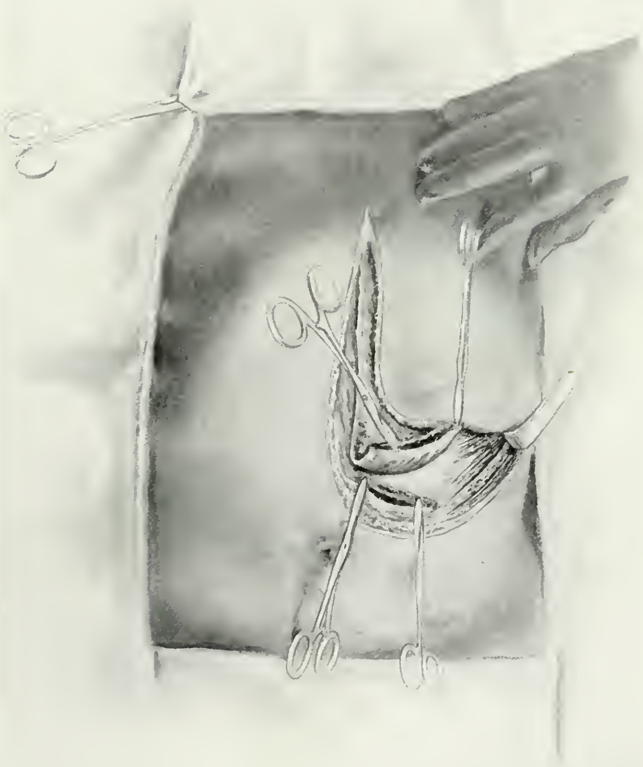


FIG. 5.



at least, has given us the best access to the upper left quadrant of the abdomen.

The incision used is a reversed "J" (see Figs. 1–5). The vertical portion starts one cm. to the left of the middle line, at the tip of the ensiform cartilage and is continued downward to the level of the umbilicus. It is then carried outward across the rectus and outward and upward toward the tip of the seventh rib. The rectus muscle is cut transversely, preferably at the linea transversa. The external oblique and the transversalis muscles are separated in the direction of their fibres; the internal oblique fibres are cut across. The flap can then be turned up and out giving free access to the splenic area.

We consider that this incision not only gives us the best operative exposure but also greatly lessens the dangers of post-operative hernia. The blood supply of the flap is not interfered with on account of the free anastomosis with the vessels of the chest. The nerves supplying this area, coming as they do from the lower intercostals, run parallel with the transverse portion of the incision and therefore are not cut across. The transverse incision of the rectus has already proven satisfactory and the splitting of two of the three layers of the lateral wall adds greatly to the post-operative strength.

Having obtained the proper exposure, the greatest remaining difficulty lies in the efficient ligation of the vascular pedicle. Mayo and Sutherland both strongly urge the use of a temporary rubber covered clamp on this pedicle before ligation and the thorough testing of the ligatures before the complete removal of the clamp.

Extirpation of the spleen has been performed for various conditions by many operators and the consensus of opinion is that while the operation is a serious one with high mortality, it is entirely justifiable under certain conditions. The statistics for splenectomy from any cause compiled by Bessel Hagen in 1900, and by Johnson in 1908, show a mortality of 36.3 per cent. in a series of 353 cases and of 18.5 per cent. in a series of 355.

In splenic anæmia, splenectomy during the first and second stages gives far better results than any other form of treatment. The production of toxins which affect the blood, liver and other organs is stopped and nature is given a chance to repair the damage already done to the rest of the system. The anæmia rapidly decreases. The resistance of the red blood cells is increased to above normal. The icterus and gastro-intestinal symptoms disappear and weight and strength are regained. The effects of the removal of the spleen in this condition resemble closely those following thyroidectomy for exophthalmic goitre. In both, the secondary and presumably the major, but not the primary source of intoxication, is removed, and the resultant marked improvement in the patient's health, while perhaps not so rapid, is as sure and as permanent from splenectomy as from thyroidectomy.

In cases reported up to the year 1908 splenectomy in the first or second stage gives a mortality of 17 per cent. This figure is based on the reports of Simmonds and Torrance, who collected in all thirty-five cases, with only six deaths. From 1908 to 1912 the results have been even more favorable. Forty-seven cases have been reported by various authors in which splenectomy has been performed before the appearance of Banti's symptom-complex. Of these cases only 5 or 10 ⅛ per cent. have died. It is impossible to state with absolute confidence that splenectomy gives a permanent cure, but at least it can be said that the majority of these cases have been followed for 1 to 9 years after operation and a few have been under observation for 12 years and in no case has there been a return of the previous symptoms.

A case reported by Banti may be cited as typical of the great improvement brought about by early splenectomy. The patient, fifty years of age, with a history of typical symptoms lasting over a period of fourteen years, was operated upon in February, 1903. In October, 1902, the blood count showed Hb. 60 per cent.; R.B.C. 3,760,000; W.B.C. 8,180. In February, 1903, just before operation, the count was Hb. 25 per cent.; R.B.C. 1,615,000; W.B.C. 7,060. One week after operation Hb. was 35 per cent.; R.B.C. 2,565,000; W.B.C. 26,000. Ten months later Hb. and R.B.C. had reached normal and W.B.C. were down to 11,000. The counts taken two, five and nine years later were normal in every respect. In 1911, when the last count was taken there had been no return of symptoms.

In the third stage however, we find a very different story. Here the results of a chronic poisoning have asserted themselves. The vital organs are showing signs of permanent degeneration. The liver has become cirrhotic and we are dealing not with an anæmia alone, but with a degenerative process affecting many organs. Nothing we can do to the spleen will restore the liver cells already destroyed, or prevent the symptoms arising from such destruction. All that we can hope for is to prevent further degeneration. For this reason splenectomy in the third stage has given much poorer results than in the early stages, although a few isolated cases have been reported showing complete recovery in early third stage following splenectomy. In 1908 Simmonds reported six cases following splenectomy, with four deaths, and Torrance five cases with four deaths, giving an average mortality of 72.7 per cent. In the past four years sixteen cases are reported with 9 deaths, giving a mortality of 56 ¼ per cent.

It is perhaps unfair to place too great reliance on the statistics just given. In a disease as rare as the one under discussion, it is extremely unusual to find more than one or two cases reported by a single author. Only the very largest clinics can report a sufficient number of cases to make the statistics reliable. The majority of the single cases reported show a favorable result and it is only reasonable to suppose that many terminating unfavorably have not found their way into literature. However, in the past two years, two articles reporting a series of cases have been published and on this account should perhaps deserve special mention. Mayo, in 1910, reports ten cases of splenectomy for enlarged spleen. Seven of these were undoubtedly splenic anæmia, five being in the early stage, and two in the terminal stage; of these, one resulted fatally and was a case showing advanced cirrhosis of the liver and ascites. The other article by Urbino comes from Burci's Clinic, in Florence, and reports seven cases in the early stages with one death, and two cases in the terminal stage, both of which died.

In the past few years the combination of splenectomy and Talma's operation has been suggested and successfully accomplished. It undoubtedly holds out more chances for permanent relief and would seem to be the most rational procedure in the ascitic stage. The attempts are yet too few to state the results with any accuracy.

Complications.—The convalescence following splenectomy varies in no way from that following any operation on the upper abdomen except in two points: First, the danger of gastro-intestinal hemorrhage and second, the lowered resistance to any secondary infection. Hemorrhage into the stomach or upper intestines is the most common as well as the most severe complication. It may occur immediately after operation or at any time during the first two weeks. The loss of blood may be rapid, or as is usually the case, the leakage may be slow, persistent oozing from the mucous membrane of the stomach and upper intestines. It is the most common cause of death in the first two weeks. The frequency of its occurrence cannot be readily estimated. Urbino lays emphasis upon it and noticed it in five out of seven cases. Mayo mentions it as a cause of death in the only fatal case in his series. The treatment consists in absolute rest of the upper gastro-intestinal tract; injections of saline, vasoconstricting drugs, blood serum, or even direct blood transfusion. A case of Dr. Donald Guthrie's, operated upon during the past year, may be cited as typical of this condition.

This case, a young adult male, was seen by Dr. Guthrie in November, 1911. The examination at this time showed a case of splenic anæmia of three years' duration, in the second stage. The blood picture gave a hæmoglobin of 46 per cent.; R.B.C. 4,230,000; W.B.C. 5,600. The lower border of the spleen extended into the pelvis. Splenectomy was performed. During the first five days after operation the recovery was uneventful. At this time he began to pass small quantities of blood by the bowel. This lasted two days and was controlled by injections of normal blood serum. Patient then had no trouble for one week and was able to be up and about in a wheeled chair. At that time he again had attacks of bloody diarrhœa and in spite of saline and blood serum injections the hemorrhage recurred and he died three days later. A post-mortem was made. The vascular pedicle of the spleen was found to be in good condition. In the lower half of the small intestine the mucous membrane showed innumerable small hemorrhagic areas. The mucous membrane of the stomach and of the upper small intestine showed congestion but no hemorrhage.

The danger of secondary infection can perhaps be classed as a post-operative complication. There is undoubtedly a lower resistance to any of the pathogenic organisms, which lasts for months after the removal of the spleen. This fact has been amply proven both by the clinical findings and by experimental work on splenectomized animals.

A case operated on by Dr. C. H. Frazier, in the Hospital of the University of Pennsylvania, during the past winter, is a good example of this condition. A colored girl, aged eighteen years, with a splenic anæmia in the first stage was operated on and the spleen removed. Her convalescence was uneventful until the tenth day when she began to run a temperature and developed signs of pneumonia and pleural effusion at the left base. This was followed three days later by an empyema which was tapped and a few ounces of sterile turbid fluid removed. The chest condition gradually improved. Thirty days after the operation she began to develop signs of gastro-intestinal disturbance with vomiting, distention, etc. Three days later dulness in the flanks developed. The abdomen was opened in the suprapubic region and a large pocket of thick, green, foul-smelling pus evacuated. The upper abdomen seemed to be walled off from this pocket. Six weeks later the patient's general condition had markedly improved, although there was still slight drainage from the abdominal wound.

Conclusions.—1. Splenic anæmia is a disease entity characterized by a definite symptomatology and pathological picture, and the so-called "Banti's disease" is its terminal stage.

2. In all probability the primary cause of splenic anæmia is a toxæmia, the origin of which is to be sought for outside the spleen itself, possibly in the gastro-intestinal tract, but the exact nature of which is as yet unknown. This toxin probably acts primarily or secondarily on splenic cells, causing an hypertrophy and increased activity.

3. This increased splenic activity is responsible for the anæmia probably through a decreased resistance of the red blood corpuscles. The icteric pigmentation is also due to an increased hæmolysis.

4. Although the thrombophlebitis of the splenic and portal veins is a frequent finding clinically, we believe, from our own experimental work and that of others, that it is not an essential factor in the etiology. If the theory of a primary toxin

is correct, we suggest that the blood coming from the spleen to the liver should be doubly toxic in that it contains not only the primary toxin, but that also elaborated by the splenic substance. To our minds it is the action of this doubly toxic blood that causes the endophlebitis of the splenic and portal veins with its consequent thrombosis.

5. In all probability these same toxic factors play the important rôle in the production of liver cirrhosis, although the mechanical factor of congestion of the portal system may be an additional cause.

6. Up to the present time treatment other than surgical has yielded only temporary benefit.

7. Splenectomy in the first and second stages offers us our only chance of permanent cure. The mortality is 12.5 per cent.

8. Splenectomy in the third stage will arrest the further development of the disease but will not cause a retrogression of the liver cirrhosis. In a few isolated cases of early cirrhosis permanent cure has followed removal of the spleen. In the past five years mortality following splenectomy when done in the third stage has been 56 ¼ per cent. The combination of splenectomy and Talma's operation should be the procedure of choice in this stage.

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EXACTNESS IN DIAGNOSIS AND CONSERVATISM IN TREATMENT OF RENAL CALCULUS.

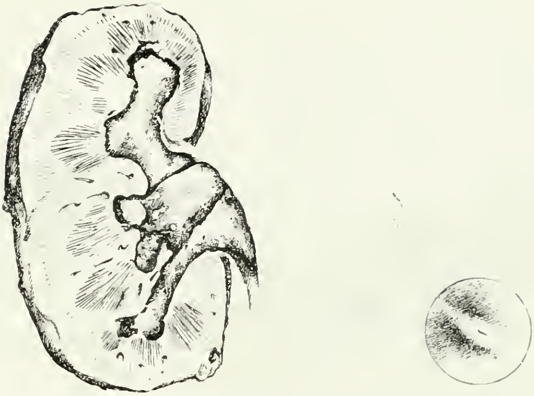
BY PAUL MONROE PILCHER.

In the past the efforts of surgeons to remove a calculus from the kidney have been accompanied by considerable traumatism to the organ itself. The kidney has been roughly handled, its parenchyma laid open, and the finger used to explore the various calyces and the renal pelvis. All of these procedures are unquestionably dangerous, and prompt the question: How can the surgeon avoid them and still remove the calculus from the kidney? In answering this question it may be said, first, that every means possible should be employed to establish an exact diagnosis, and that one should never operate upon a patient for renal calculus, basing his diagnosis on subjective symptoms alone.

So typical is the picture in many cases that few clinicians could fail of a correct diagnosis. However, when a surgeon has seen a number of patients suffering with the usual symptom complex, and yet has failed with the X-ray, cystoscope, or by operation to disclose a stone, he realizes that there are other conditions, some even entirely outside of the kidney, which may cause the symptoms. Gall-stones are seldom confusing; chronic appendicitis with a pericæcal veil of adhesions extending upward toward the kidney frequently is; perirenal adhesion, subcortical hemorrhages, acute congestion of the kidney causing a stretching of the capsule, and acute inflammatory diseases of the pelvis and parenchyma of the kidney are the most frequent conditions which simulate the symptoms of renal calculus.

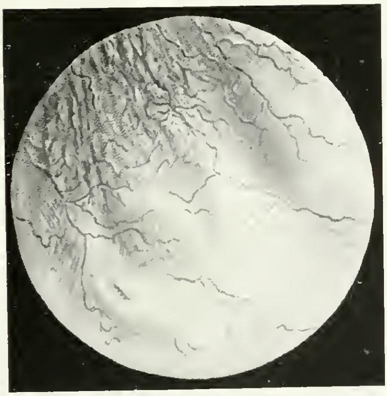
Pain in the kidney not affected has frequently been observed. Personally, the writer has seen only one or two cases in which the excruciating pain of renal colic was referred to

FIG. 1.



Kidney with large branched stone filling pelvis and appearance of corresponding ureter opening. (Pilcher's Cystoscopy.

FIG. 2.



Cystoscopic picture of ureter opening corresponding to a kidney containing a stone in its pelvis. (Pilcher's Cystoscopy.)

Fig. 3.

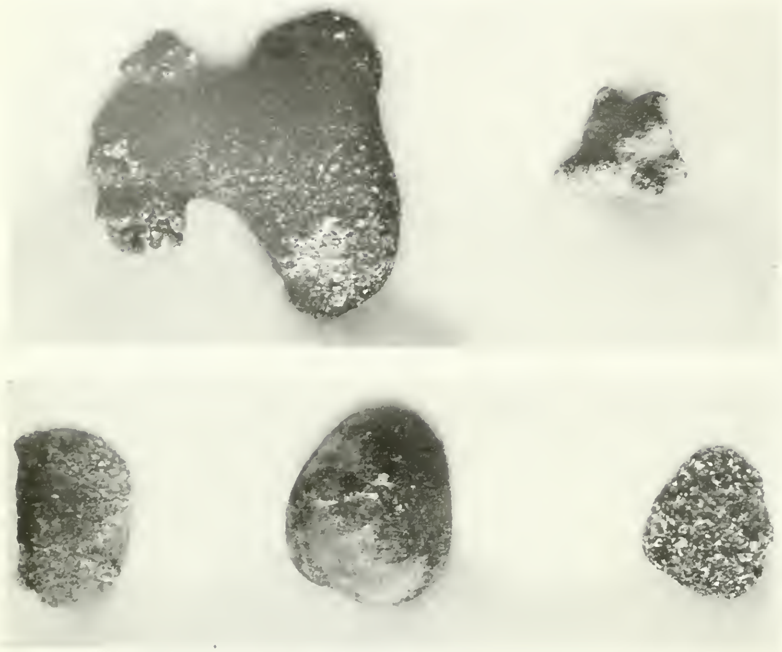


Plate showing variety of shapes and sizes met with in cases of renal calculus.

Stones which originated in the kidney, gave rise to repeated attacks of renal colic and were passed naturally from the urethra without operation.

the wrong side, but he has often noted that between or immediately following attacks of renal colic, from whatever cause, the sound kidney will ache and give more trouble than the diseased one. This probably is due to the compensatory hypertrophy or acute congestion arising as a result of its unusual activity during the renal spasm of its companion, aided by a renopelvic nervous reflex.

THE DIAGNOSIS.

Following out the practice that one should never operate upon a patient for renal calculus, from a diagnosis based on subjective symptoms alone, it may seem strange to specify that in every case a urinary examination should be made, but it is a fact that some surgeons will operate upon a kidney for supposed renal calculus, basing their opinion entirely on the subjective symptoms and physical examination alone. Moreover, it is not to be overlooked that there are cases in which all the typical symptoms of renal calculus are lacking, the affection not being discovered until much damage has already been done to the kidney.

In all cases of suspected renal calculus it is possible to determine by urinary examination: the presence or absence of blood in the urine; the presence or absence of pus in the urine, and its amount; the existence of a chronic or active nephritis.

The *cystoscope* is useful as a minor aid to diagnosis in these cases. The changes in the bladder are never sufficiently characteristic to be of value. The ureter catheter, with or without its waxed tip or metal point, is less useful than the Röngten ray, but may afford valuable confirmatory evidence.

The chief value of the cystoscope in renal calculus is to establish the functional activity of each kidney and, in connection with the X-ray, to determine the relation of the stone to the renal pelvis; to determine the presence of a calculus in the ureter or bladder, and to demonstrate the condition of the bladder. We are dealing strictly with renal calculus. Where a calculus is descending the ureter, the cystoscope is of greatest diagnostic value. It helps us also to determine the size of the renal pelvis.

The Ureter Opening.—During the acuteness of an attack, the sphincter of the corresponding ureter opening appears tightly contracted; after an attack is over, the meatus is more relaxed, congested, and, in some cases, swollen. Where a chronic pyelitis is present the picture does not differ from that accompanying other descending infections. The bladder mucosa is not altered unless infection is present. As a rule there is just sufficient change in the appearance of the corresponding ureter opening to determine the side on which the lesion is.

Urinary Efflux.—One seldom has an opportunity of observing this during an acute attack. In one case examined by the writer the diseased side showed a slow dribbling of urine, while the normal kidney was delivering urine to the bladder in strong, rapid spurts, showing the reflex stimulation.

Functional Tests.—In almost all grades of renal calculus the functional activity is impaired. The degree of the disturbance depends entirely on the individual case. The tests are important in determining the indications for treatment. The disease affects equally the phloridzin, indigo-carmine, and phenolsulphonephthalein tests. The greater the amount of renal destruction, the more advanced will be the functional derangement.

X-ray Examination.—This is insisted upon in every case in order to determine the size, position, and number of calculi present. *We feel that a calculus which is so small as to be undetected by repeated X-ray examinations is probably small enough to pass out without surgical operation.* A large single shadow may be cast by one stone or by a group of stones massed together. A number of shadows arranged along a vertical or oblique line usually indicate multiple stones in the dilated calyces of a hydronephrotic kidney, and are probably contained within the shell of a kidney which should be removed.

The X-ray helps us materially to choose the type of operation suited to the particular case. For example, *an oxalate stone gives one of the densest shadows on an X-ray plate.* An oxalate stone is slow in its development, is usually situated low down in the renal pelvis, and is easily removed by pyelolithotomy. Therefore, if we have a patient who has repeated attacks of renal colic, or a fixed loin pain, with occasional hæmaturia, with a urine that is loaded down with oxalate of calcium crystals, in the absence of bacteria, and the X-ray shows a round-shaped stone below the free border of the ribs, one may be fairly certain that by a lumbar incision, a careful exposure of the kidney, and an incision of the renal pelvis on its posterior surface, the stone can be removed with little danger of a long-continued urinary fistula resulting. If, however, in a patient with the same symptoms and in whom the urinary findings are identical, we find an oval-shaped stone situated in the upper pole of the kidney, the shadow in the radiograph showing well above the free border of the ribs, it is fair to assume beforehand that the pelvis of the kidney is contracted by irritation, that the stone is situated high up within the kidney, and that it cannot always be satisfactorily exposed through the renal pelvis. Without attempting, then, in such a case to do a pyelolithotomy, a cortical incision limited in its extent will quickly and safely expose the stone and allow of its removal.

On the other hand, if the X-ray shows a triangular stone with the apex pointing inward or downward, in the presence of an alkaline urine, usually without hæmaturia and without a history of much pain or repeated colic, with an excess of phosphates in the urine, it is logical to conclude that the stone obstructing the pelvo-ureteral junction is composed of phosphates, and is the beginning of a dangerous branching stone which sooner or later will destroy the kidney itself. Such stones often have small branches which fracture easily and do not show on the X-ray plate. Under such conditions it is still often possible to remove the stone entirely through a restricted opening in the renal pelvis. If the stone when removed shows that a portion of the calculus has been broken off from the main mass, the remaining fragment can sometimes be removed by incising the calyx, or, if necessary, by a cortical incision. At any rate, the existence of such a stone is an absolute indication for operation.

Again *the urate stones are very frequently multiple.* On an X-ray plate we will sometimes find a large stone blocking the ureter opening, and below this shadow are seen indications of a number of smaller stones in the kidney substance. Such a picture would indicate a considerable destruction of renal tissue with the formation of dilated calyces, in the bottom of which are contained multiple calculi which are lower down than the one at the ureteropelvic junction. Such a case might well be approached by a combined pelvo-ureteral and cortical incision, for it is practically impossible to remove all the small stones contained within a dilated calyx through an incision in the renal pelvis.

TREATMENT.—A patient who has had only one attack of renal colic is not necessarily a surgical case; one might safely say that *there are more renal calculi passed into the bladder and through the urethra than ever remain imprisoned in the kidney.* The danger in making such a statement lies in the fact that when a physician comes to accept it, he is apt to treat a primary renal colic medically, hoping there will be no recurrence, and he does not insist upon a complete diagnosis, thus exposing the patient to the danger of harboring a calculus which is too large to pass, and which will eventually destroy the kidney. Therefore, in all cases of renal colic, an X-ray examination should be made, and a careful watch be kept upon the urine.

The X-ray has been especially valuable in differentiating cases of renal calculus which are surgical. For example, we often see cases of recurrent attacks of renal colic due to the formation of small renal calculi which are essentially not surgical cases. As an example of this class of cases I may cite the following:

CASE.—A man forty-one years of age, had had rheumatism since childhood; for eight years had suffered from indigestion, with pain in the back, persistent headaches, and nausea. Two years ago he had an attack of renal colic on the left side, with vomiting and high fever; pain at first on the left side and then on the right side; has had recurrent attacks similar to this, with pain originating on both sides and passing along the front down along the course of the ureters, ending in the bladder. The patient has had three or four very severe attacks for which morphine was used; has passed many small stones of different sizes and shapes from the bladder.

Cystoscopic examination revealed both ureters thickened as they passed through the bladder, and both the right and the left ureter openings were somewhat dilated; there was no stone in the bladder; specific gravity of the urine, 1.033; total acidity of the urine, using a N/10 sodium hydrate solution, of 90 (normal being 35 to 40); therefore urine intensely acid, and contained many large uric acid crystals and clumps of crystals; also contained blood, but no pus. Two calculi, which were passed the day previous, were fairly large and rough, typical uric acid calculi, the larger being nearly three-eighths of an inch in length and three-sixteenths of an inch in width. A careful examination of these calculi which were passed showed a broken surface, as if these pieces had been broken off from a larger stone. We had all the symptoms of a large calculus in one or both kidneys, from which occasionally small pieces would break off and pass out; and yet when an X-ray examination was made no calculus could be found in either kidney, either ureter, or in the bladder.

If the calculus is small and is evidently descending, it should be allowed to work its way down, if possible. When it arrives at the vesical portion of the ureter it may be necessary to inject oil around it, dislodge it by instruments, or enlarge the ureter opening to facilitate its escape.

When, however, the stone in the kidney is too large to pass, it should always be removed by operation even if active symptoms of its presence are lacking, providing the kidney is still functionating normally and the second kidney is not diseased.

The three methods now employed for accomplishing this are: pyelolithotomy, nephrotomy, and nephrectomy.

Usually when the X-ray shows the stone contained within the substance of the kidney itself, the cortical incision alone is indicated.

The aim of the surgeon is to remove the stone with as little injury to the kidney as possible. The old fear of persistent urinary fistula following incision of the pelvis of the kidney is no longer present, for, as I will show later, the more advanced methods of operation have eliminated this.

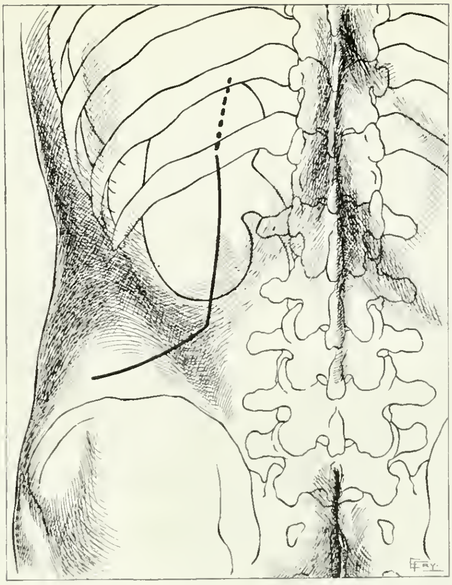
I mention these facts and have tried to show how fairly accurate conclusions may sometimes be drawn from a careful study of the symptoms in combination with radiography, in order to emphasize the fact that they have a distinct bearing upon the character and safety and completeness of an operation for renal calculus. The subjective symptoms draw our attention to the condition. The urinary examination in combination with radiography and cystoscopy establish and define the exact diagnosis.

CHOICE OF OPERATION.

Our choice of operation is, first, pyelolithotomy; second, nephrotomy; and third, nephrectomy. Broadly speaking, *pyelolithotomy is indicated* in a case where the stone is situated wholly within the pelvis of the kidney, in the first portion of the ureter, or in the lower calyces of the kidney, provided the pelvis is dilated. It is *contraindicated* in a kidney which is bound down by strong adhesions so that it cannot be brought well into the wound; also where the fatty fascia surrounding the renal pelvis is friable and infiltrated with inflammatory exudate; *it is difficult* in those cases where a short pedicle is implanted high within the kidney. The short renal pedicle is not always a contraindication, provided the kidney can be well exposed. The operation is apt to be difficult in stout patients, but as one becomes more expert in operating upon the kidney it is possible to perform a pyelolithotomy without delivering the kidney into the wound.

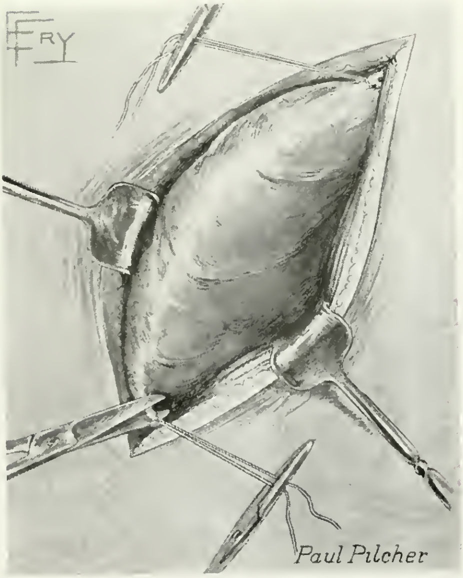
Nephrotomy is indicated where pyelolithotomy cannot be performed, providing the parenchyma of the kidney has not

Fig. 4.



Line of incision for exposing kidney.

Fig. 5.



Freeing the kidney in order to bring it more freely into the wound. It will be found that there are generally vessels entering the kidney both at its upper and lower pole. In order to prevent hemorrhage from those tissues, whether they contain vessels or not, they are tied with catgut ligatures and divided.

been extensively destroyed, and providing suppurative pyelonephritis is not present. It is the writer's belief that the kidney which is the seat of a suppurative pyelonephritis should always be removed and never be incised, if the functional capacity of the second kidney will permit of it. It is a mistake to think that the shell of a kidney is of use to the human economy; it is rather a great source of danger, and will embarrass the second kidney, even if that, too, is partially destroyed.

The technic of pyelolithotomy is very simple, but the observances of general principles involved in the various steps of the operation are important to its ultimate success.

TECHNIC OF PYELOLITHOTOMY.

Incision.—The writer prefers an incision which begins two and one-half inches from the spines of the vertebra at a level with the last rib. It is continued straight downward to within an inch of the crest of the ilium, and is then carried forward parallel to the crest of the ilium. Considerable care is taken in making this incision. The incision parallel to the spines of the vertebra does not cut any muscle fibres, and the continuance of this "flail" incision divides the fibres of the external and internal oblique muscle (Fig. 4).

One of the most important details influencing the success of the operation of pyelolithotomy is a good exposure of the field of operation, and the original incision should be completed before the kidney is exposed, for in this way the muscles are best conserved. The kidney then is exposed in the usual way, is dislocated from its bed and brought into the wound, and a careful inspection of the kidney and pelvis is then made. If it is not possible to deliver the kidney, the case is one unsuited for pyelolithotomy, for, as I have stated elsewhere, the traumatism consequent to the delivery of the kidney which is bound down by dense adhesions of inflammatory exudate is more harmful than a clean cortical incision through the substance of the kidney.

Basing our steps on the diagnosis already established, we may meet with *three distinct problems: First,* one in which the stone, usually an oxalate stone, is contained well within a renal pelvis of a normal size, but whose walls are somewhat thickened by irritation; *second,* a renal pelvis which is very considerably dilated, due to the lodgement of a movable stone at the pelvo-ureteral junction; this stone can be dislocated upward into the dilated renal pelvis; *third,* a fixed stone at the pelvo-ureteral junction, usually with a constriction above it which prevents it from being dislocated (see Fig. 12).

In the first instance the technic of the operation is as follows (Figs. 6, 7 and 8):

The fatty fascia covering the renal pelvis is incised along the line parallel to the vertebral spines, thus exposing the renal pelvis. Retractors are used to more freely expose the walls of the renal pelvis, which is incised in a line diagonal to the line of incision of the fatty fascia, and the stone is exposed and removed. If feasible, the pelvic wall is closed with a running catgut suture, and the fascia flap is closed by a second layer of running sutures over the first. In this way we will, in the great majority of cases, obtain a primary union in the wound, even where a moderate grade infection exists.

Where it is impossible or not feasible to suture the renal pelvis it may be left open without fear of a urinary fistula following, *providing the ureter is unobstructed.*

In the second instance *where the pelvo-ureteral junction is occupied by a movable calculus* and the pelvis is considerably dilated, an incision should be made through the fatty fascia overlying the lower portion of the renal pelvis, the stone dislocated upward from its position, an aspirating needle introduced into the pelvis and the fluid removed; the pelvis then incised and the stone removed, and the wound closed as in the first instance (Figs. 10 and 11).

In the third case *where the stone is impacted and immovable at the pelvo-ureteral junction,* a curved incision is made in the fatty fascia, exposing directly the site occupied by the stone; a vertical incision is made across the neck of the constriction of the pelvis, exposing the stone which is removed through this opening, and then the upper and lower angles of the wound are drawn together and the wound sutured in such a manner that the line of incision becomes horizontal instead of vertical, thus causing a dilated portion of the ureter where a stricture previously existed (Figs. 12 and 13).

These in general, then, are the points in operative technic for conservative work on renal calculus. In a relatively large number of cases pyelolithotomy may be carried out, and we can feel sure that the wound following the operation will heal by first intention. In a certain number of cases the more conservative operation must be replaced by the cortical incision, the indications for which are fairly well defined; but lastly, it has been our experience that *it is a very dangerous experiment to try any conservative operation upon a kidney which is the seat of a suppurative pyelonephritis,* whether it is complicated by stone formation or not.

A presentation of this subject should not be attempted without acknowledging our indebtedness to Fenwick, of London, and William Mayo,[1] of Rochester, for the work they have done in advancing this branch of renal surgery.

ILLUSTRATIVE CASES.

CASE I.—*Bilateral renal calculi; chief symptoms referred to left kidney owing to descent of calculi into ureter; large branched calculus filling pelvis and calyces of right kidney; removal by pyelolithotomy.*

Admitted to the Pilcher Hospital February 9, 1913. Twelve years ago ovaries were removed, together with multiple small fibroid tumors of the uterus which were supposed to cause irritability of the bladder. Ten years ago had violent attack of colic of the bladder, characterized by violent pain low down in the abdomen and inability to urinate. These symptoms gradually improved and patient was in good health. June 15, 1912, she began to have a sense of discomfort referred to the left side and back, evidently renal; then an acute renal colic referred to the left side, which lasted for three hours, and caused much prostration; pus and blood in the urine. Following that for three or four days had similar attacks, but less severe. Now urinates every hour, night and day; is never free from desire to urinate. Paroxysms of pain start in the region of the left kidney, pass down the left side to the bladder. Need of urination every few minutes at such times. Later the pain was severe in the bladder.

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[1] MAYO, WILLIAM J.: Surg., Gyn., and Obst., April, 1910, pp. 363–365.

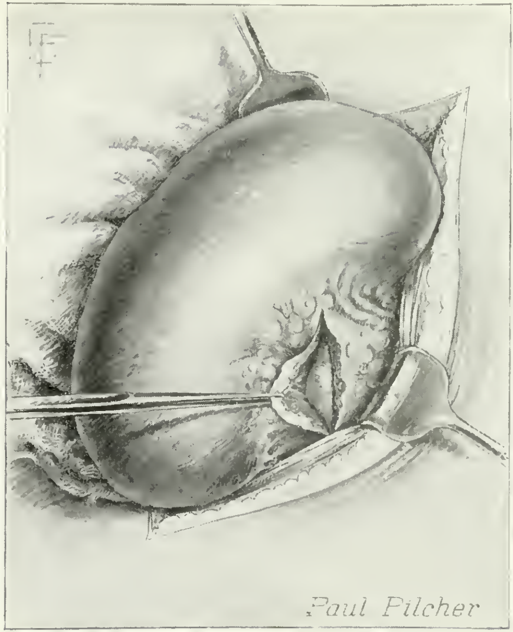
Cystoscopic examination, September, 1912, showed the bladder to be normal; no obstruction in the ureters; urine from left kidney contained blood. Examination of the bladder urine showed pus and blood to be present.

X-ray examination by Dr. Eastmond in September showed a branched stone in the right kidney and multiple stones in the left kidney. An X-ray examination by Dr. Caldwell, of New York, some weeks later, showed left kidney clear, an oblong stone in the left ureter near the bladder; branched stones in the right kidney.

In the history given there was no complaint referable to the right kidney and yet the X-ray shows in it a collection of stones which is very striking. A more close cross-examination of the patient brings out a history of previous symptoms pointing to the right kidney. These are not of recent date, but more probably deal with that period when the original stone was forming and small bits of stone or large collections of crystals were passing along the ureter (Fig. 14).

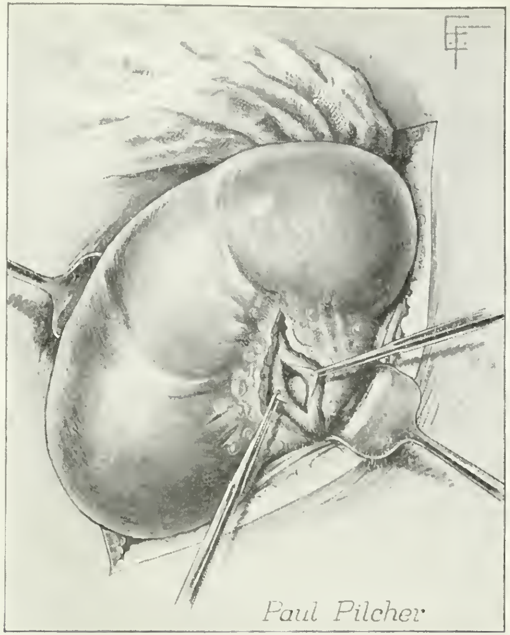
At the present time attention is drawn toward the left kidney because a stone has entered the ureter and is making its way downward to the bladder. The first attack of pain is evidenced when the stone engages at the ureteral intake. This portion of the ureter is very dilatable and with the continued spasm of the walls of the renal pelvis and the added dilatation due to the blocking of the ureter the stone is gradually forced downward, being arrested either at the brim of the bony pelvis or, passing this, engaging at the ureterovesical junction. So we may explain the symptoms in this case. The relatively small cylindrical stone with blunted ends shows clearly in the picture. This X-ray shadowgraph tells its own story. It demonstrates most strikingly the difference between the shadow of a ureteral stone and that of a phlebolith. Many opinions to the contrary, the relative positions of the stones are quite characteristic. The pelvic ureter seldom varies its position and is far nearer the median line than the veins which contain phleboliths. Then again, the phleboliths are usually multiple, round and clear-cut, while the edges of an impacted stone are blurred by the inflammatory exudate occasioned by its pressure in the ureter; ureteral stones are usually single.

FIG. 6.



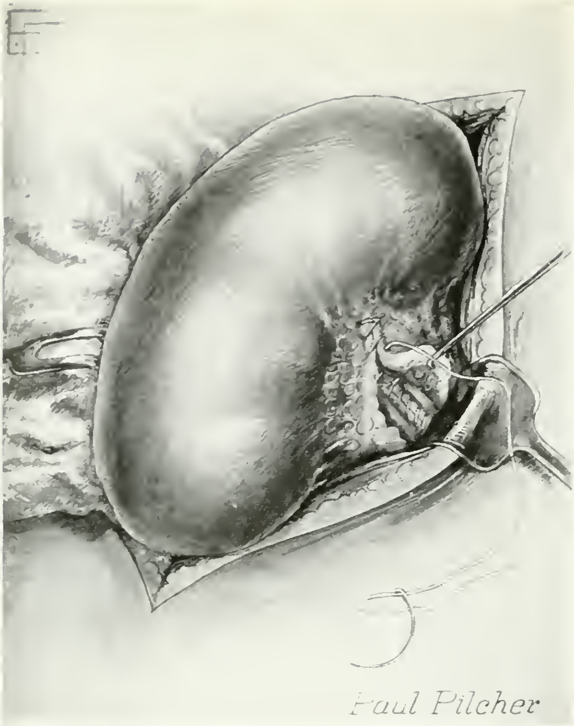
Showing the first step in exposing the renal pelvis after the kidney has been mobilized and brought into the wound; the posterior surface of the kidney is shown. A vertical incision is made through the fatty fascia surrounding the renal pelvis, exposing the external wall of the renal pelvis.

FIG. 7.



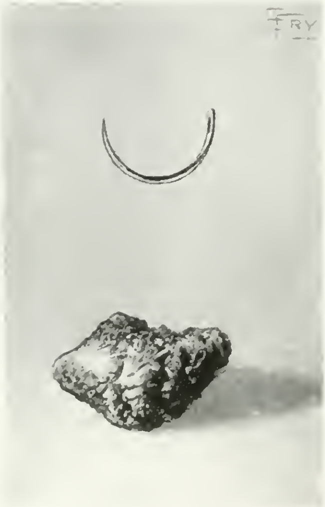
Showing the second step after the pelvis of the kidney has been exposed by an incision through the fatty fascia. A second incision is made through the wall of the pelvis, cutting down upon the stone directly, if possible. The stone is expressed through this opening and the incision in the renal pelvis is closed by a running suture of silverized catgut.

FIG. 8.



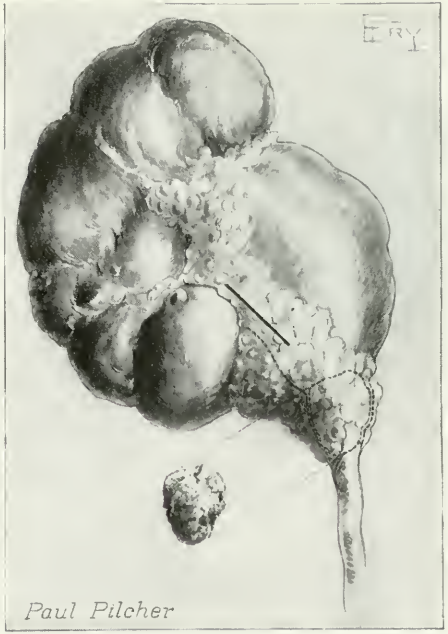
Last step showing the pelvis of the kidney sutured by a running catgut suture and the fascial flap being sutured over this. The two lines of suture only cross at one point.

FIG. 9.



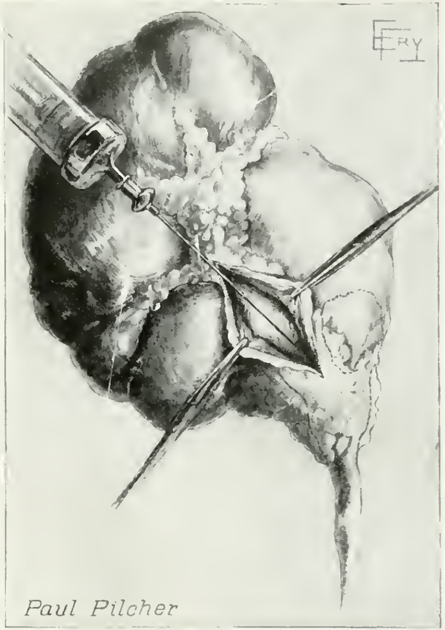
A [illegible] curved needle is used to suture the opening in the pelvis of the [illegible] fatty fascia. Below is shown a stone removed from the kidney pelvis by [illegible]

FIG. 10.



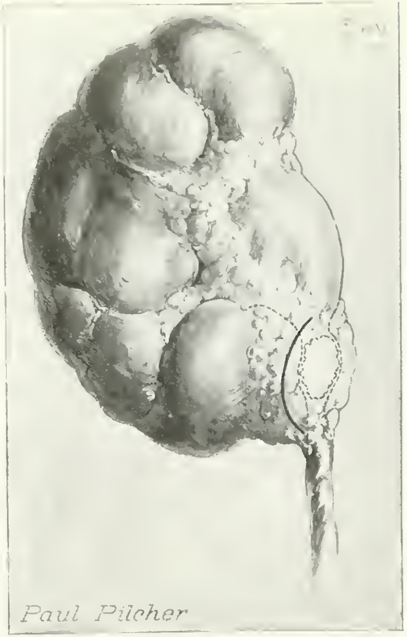
The pelvo-ureteral junction is occupied by a movable calculus, and the pelvis is considerably dilated. The *first step* is the dislocation of the stone upward into the dilated renal pelvis; the *second step*, an incision made through the fatty fascia over-lying the lower portion of the renal pelvis, exposing the wall of the pelvis.

FIG. 11.



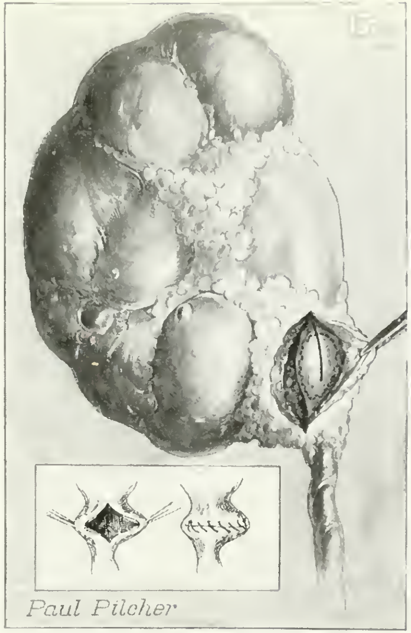
In a case where a movable calculus occupies the pelvo-ureteral junction. Second step, after the exposure of the wall of the renal pelvis an aspirating needle is introduced and the hydronephrotic fluid is removed. The wound is closed by a running silverized catgut suture, and the fatty fascia is sutured over the first suture line by a continuous suture.

FIG. 12.



Showing the stone impacted and immovable at the pelvo-ureteral junction. In this case a curved incision is made through the fatty fascia, exposing directly the site occupied by the stone.

FIG. 13.



Second step in a case where the stone is impacted and immovable at the pelvo-ureteral junction. After the site of the constriction has been exposed a vertical incision is made across the neck of the constriction, exposing the stone directly, which is removed through this opening. The smaller diagrams show the manner of closing this wound; the upper and lower angles of the wound are drawn together and the wound sutured in such a manner that the line of incision becomes horizontal, instead of vertical, thus causing a dilated portion of the ureter where a stricture previously existed.

The right kidney appears perfectly normal in conformation, its outline smooth and regular. It contains three distinct calculi and possibly a fourth which is overshadowed by the lower mass. Naturally the kidney is enlarged but the shadowgraph would indicate no area of destruction, its density being equal throughout. Also, if there was obstruction of the ureter at its inlet, a hydronephrosis would result and this would be shown by irregularities in the outline of the kidney. Studying the shadowgraph, therefore, we conclude that the right kidney is in its normal position, that its pedicle is not very long, that its pelvis is filled with a mass of calculi, and that these lie well imbedded in the pelvis and do not move downward and engage in the ureteral inlet.

Second, that there is a small cylindrical stone in the left ureter at the point where the ureter enters the bladder. The fact that the symptoms referable to the left kidney have abated is significant of the fact that the urine is passing the obstruction at present; further, that the stone may be removed in two ways, (1) by the vaginal route, and (2) by the transperitoneal route.

The indication in the present case is to remove the obstruction from the left ureter; later, to perform a nephrolithotomy in the right kidney.

In performing a vaginal ureterotomy it might be preferable to do the same transperitoneally in order to secure rapid healing of the wound of the ureter by the aid of the peritoneal exudates. Stripping up the peritoneum from off the ureter in exposing the stone should, therefore, be avoided, although it seems the logical procedure. An extraperitoneal ureterovaginal fistula is too easily established.

On October 9, 1912, another X-ray plate taken by Dr. Imboden showed the kidney shadows approximately normal in size, outline, and position. The right kidney contained three irregularly shaped stones, the two larger ones measuring 1¼ inches long and the shortest one measuring ¼ of an inch. There was also low down in the left ureter another stone. In January, 1913, the patient had another attack of discomfort in the region of the left kidney. This stopped suddenly and after that time the patient felt much better. February 8, 1913, another set of pictures was taken by Dr. Caldwell, who reported that the plates showed two large calculi branching into the calyces of the right kidney and a third calculus much smaller opposite the lower one of these two;

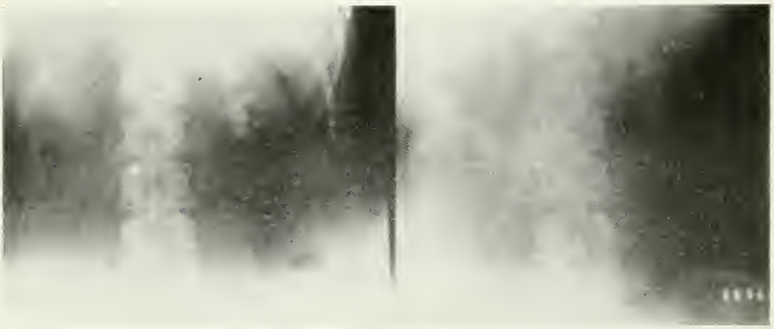
the lower of the two larger calculi having two projections not shown without the stereoscope. These extended anteriorly. There were in addition small calculous patches in the neighborhood of the upper one of the larger stones. The shadow of the calculus shown in the left ureter at the first examination made in December had disappeared and it was thought that the calculus had passed.

Functional test made February 10, 1913, showed both kidneys to be normal in function. Bladder urine, 1.016; strongly alkaline; moderate amount of albumin; traces of blood and large quantities of muco-pus with triple phosphate crystals. Urine from right kidney contained pus and blood. Urine from left kidney some blood, no pus, and an excess of large lymphocytes.

The problem, then, had reduced itself to the condition of the large branched stone in the right kidney (Fig. 15). We did not feel that pyelolithotomy was impossible even in the presence of such large calculi as these, and we therefore determined to try it in this case.

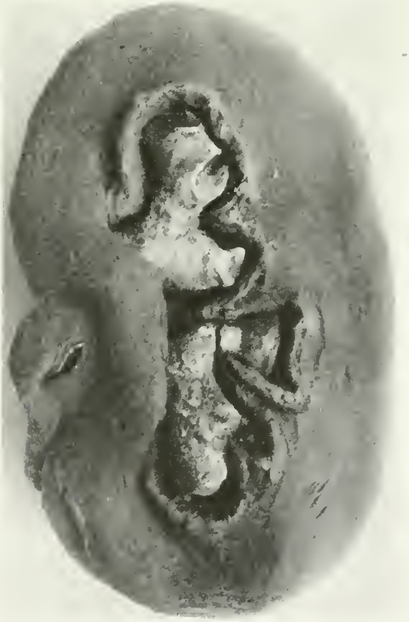
Operation: Pyelolithotomy of Right Kidney.—February 11, 1913, by Dr. P. M. Pilcher, ether by Dr. W. C. Woolsey. The usual operation was made for exposing the right kidney, freeing the attachments of the last rib in order to retract it upward. It was possible to reach the renal space without cutting across any of the muscle structures. The kidney was freed and brought up into the wound, the fascia and fatty tissue dissected away from the pelvis and a ¾ inch incision made through the pelvic wall which was found to be thickened. The finger was passed through this opening and gradually the stone occupying the lower part of the kidney was freed and removed with forceps. This stone measured one inch in length and ¾ of an inch in width and was branched, fitting into the calyces. A small fragment which had been previously broken off was removed and then the upper large branched stone was gradually freed by pushing the wall of the dilated calyces away from the stone and was delivered through the opening. This upper stone measured 1¼ inches in length, at its base was one inch across, at its middle point was ⅜ inch across and at its upper end was ¾ inch across. By the finger introduced through the opening in the pelvis a search was made of the remaining portions of the pelvis, but no other concretions were found. The opening in the renal pelvis was closed by a single running suture of silverized catgut. The kidney was replaced. A cigarette drain was carried down to the suture line;

FIG. 14.



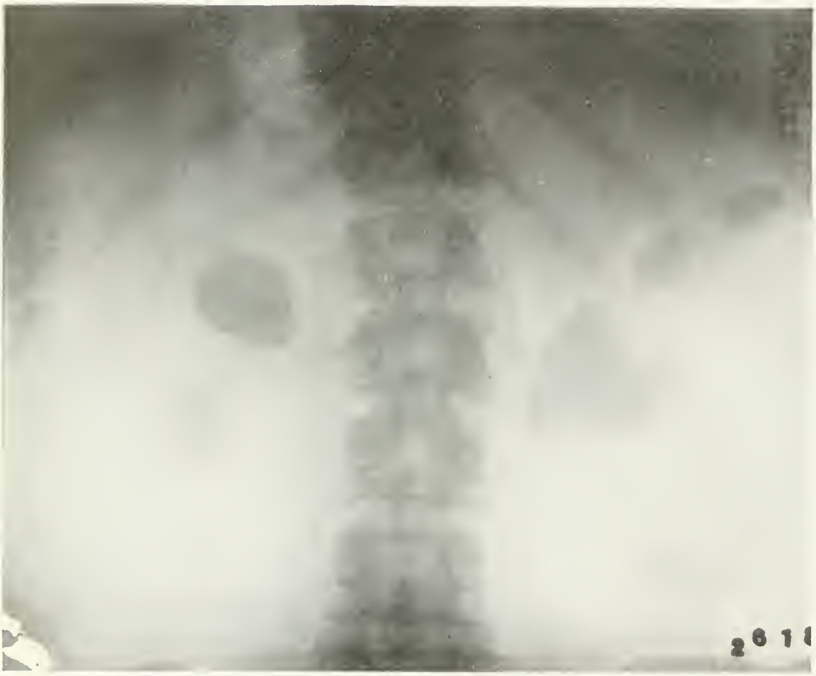
Stereoscopic X-ray plate showing calculi in Case I. The two distinct masses represent the stones in the right kidney. The outline of the kidney can be seen and is only slightly larger than normal.

FIG. 15.



Photograph of a reconstructed model, showing the stones in place after their removal from the kidney. A typical pyelolithotomy was done and through the small incision in the renal pelvis, as indicated in the photograph, the stones were successfully removed from the kidney without any injury to the kidney tissue itself.

Fig. 16.



X-ray plate of kidneys in Case II. In the left kidney are seen three masses, one at the pelvic outlet, one in the lower pole, and one in the upper pole. In the right kidney region are seen a mass of calculi, the largest one of which occupies the pelvic outlet. It will be seen by comparing this stone with the vertebra that it is of enormous proportions. By referring to Fig. 17, the stereoscopic picture, the relatively larger size of the kidneys can be seen.

a rubber tissue drain carried to the opposite side of the kidney, and a rubber tissue drain to the lower pole of the kidney. The wound was closed by layer sutures of chromic catgut with the exception of the point through which the three drains were brought out. Operation occupied an hour.

Post-operative History.—There was no leakage from the wound until about four days after the operation, at which time some urine leaked through the wound. This continued for about two weeks. Patient made a perfect operative recovery, and the wound healed entirely in about three weeks.

After History.—About three months after the operation patient had some renal colic on the right side, which passed off quickly. Since that time she has been perfectly well and has had no further symptoms of calculous disease on either side.

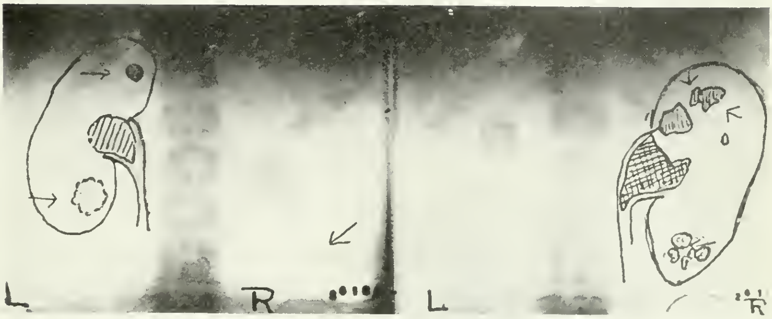
A model was made of the kidney after the operations with the stones in place, showing the opening in the pelvis through which the stones were extracted (Fig. 15). This case demonstrates that the operation of pyelolithotomy may be practical, even with a large branched stone.

CASE II.—*Hæmaturia; multiple renal calculi in both kidneys; pyonephrosis of both kidneys.*

Admitted to the Pilcher Hospital March 14, 1913. Patient referred to us by Dr. Weadon, of Bridgeport, Conn. She presented herself suffering from continued and exhausting hæmaturia, with frequent urination and a very marked pyuria with occasional attacks of severe renal colic on both sides. Thirteen years ago she was delivered of a child. Since that time she ha suffered from three miscarriages. Following her child's birth she was in poor health for some time, headaches, distress in the back, general malaise. Ten years ago she was very sick, had chills, fever, and pain in the region of the right kidney. Since that time she has had more or less backache about the level of the second lumbar vertebra on both sides. Suffers from headaches, nausea, in the morning a general feeling of being only half well. Periods, etc., normal. Some years ago an operation was done in the right lumbar region to expose the kidney, but no disease was proven at that time. She had been under treatment for months for supposed uterine trouble. Cystoscopic examination disclosed a fairly normal bladder without any distinct areas of inflammation. The right ureter was catheterized and urine containing a large amount of pus was obtained from the right kidney. The left ureter was catheterized and some urine containing less pus than that from the right kidney was obtained. There was emitted, however, from the left ureter opening large clouds of thick mucus. While the catheter was in place, the mucus oozed out by the side of the catheter into the bladder. The bladder capacity was more than 12 ounces and there were no lesions suggestive of tuberculosis; each kidney was found to be functionating equally. The right kidney was secreting a relatively large amount of pus and the left kidney a small amount, estimated at five times the amount of pus coming from the right kidney as from the left. Bacteriological examination of the pus from both kidneys showed a pure culture of Bacillus pyocyaneus. A vaccine was made from these cultures. Each kidney pelvis was drained and a drachm of 5 per cent. argyrol was injected. Phthalein test was made of the whole urine and it was found that a very small per cent. of the phthalein was excreted in the first hour, too little to be estimated. Methylene blue was also used, and only a very slight amount was excreted by both kidneys.

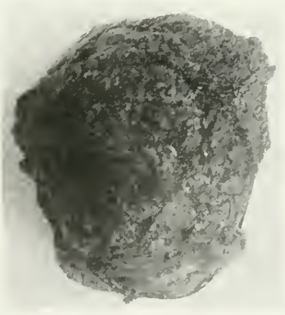
X-ray pictures were taken by Dr. Caldwell, of New York, and showed that the pelvis of each kidney was blocked by a large wedge-shaped stone. A smaller stone was in the lower pole of the left kidney and there was also one in the upper pole near the spine, the stone in the right kidney being the larger and the stone in the left kidney being half that size. The outline of the left kidney showed it to be fairly normal in size; its upper pole being occupied by a small round calculus and its lower pole by a collection of concretions which formed a calculus of considerable size. The right kidney was seen to be very greatly enlarged, being twice as large as the left kidney, and beside the large stones at the outlet of the pelvis there were two smaller stones in the calyces in the upper half of the kidney and a collection of concretions and small trash in the lower pole of the kidney (Figs. 16 and 17). The problem, then, which presented itself was primarily one of obstruction at the pelvic outlet of both kidneys with advanced destruction of the secreting tissues of both kidneys. However, as long as there was an obstruction at the pelvic outlet, it would be improbable that any improvement would be possible, therefore it was decided to relieve the obstruction at the pelvis of the more normal kidney, believing that, if this could be accomplished safely, the left kidney would re-establish its normal functions to a con-

Fig. 17.



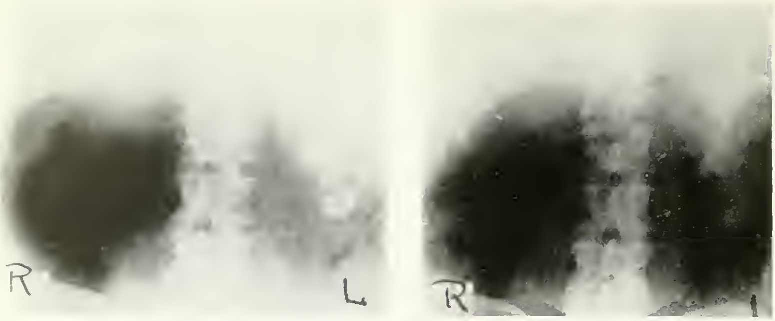
Stereoscopic X-ray of the kidney regions in Case II. The writer has outlined in ink his interpretation of the position of the various stones in the kidney. On the left side the pelvic outlet is occupied by a large stone. In the lower pole of the kidney is seen an irregular concretion, and judging by its relative circumference and the very slight shadow which it casts on the X-ray plate, it is estimated that this mass is made up of calcareous deposits on the wall of a dilated portion of the kidney and is not a free stone. The same is true of the single shadow in the upper pole of the kidney. The right kidney is seen to be much dilated and its pelvis blocked by a large stone with a series of stones in the upper pole, and the lower portion of the kidney is occupied by a mass of concretions evidently attached to the pelvic wall by a large hydronephrotic area. The problem in this case was to relieve the patient from advancing uræmia and a continuous exhausting hæmaturia. It was decided to do a pyelolithotomy of the left kidney, which was successfully carried out.

Fig. 18.



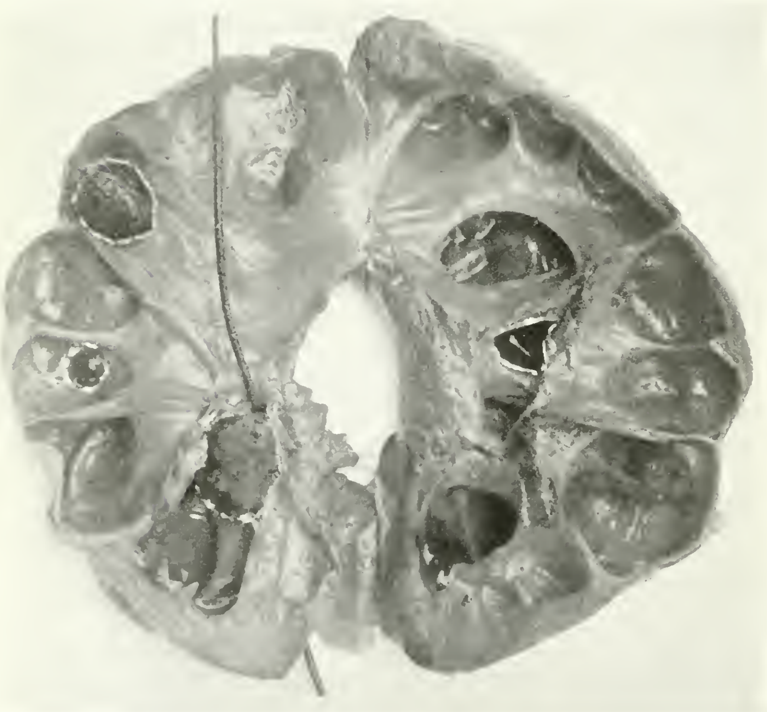
Showing a stone which was removed from the pelvis of the left kidney (Fig. 17). This calculus was made up of phosphates and uric acid crystals, and was crushed easily in removing it so that its shape is somewhat faulty.

FIG. 19.



Stereoscopic view of the kidney regions in Case III. Large masses of calcareous material are seen filling the various calyces. The portion occupying the pelvic outlet is easily determined. The only feasible operation in such a case is probably nephrectomy, but no attempt at pyelolithotomy should be made.

FIG. 20.



Kidney removed from Case IV, showing the pelvic outlet blocked by a stone and all the kidney tissue destroyed by a hydronephrotic process with multiple calculi. Only nephrectomy would be recommended in such a case.

siderable degree and at some later date a similar operation might be performed upon the right kidney. It was felt that if no attempt was made to relieve the obstruction in the right kidney it might result in a complete disorganization of that kidney, while the chances of safely removing the obstruction and stone of the left kidney were far greater, and, if only one operation could be done, the best operation was the relief of this obstruction on the left side; therefore, under ether anæsthesia the operation was undertaken.

Operation: Pyelolithotomy.—March 22, 1913, by Dr. P. M. Pilcher, ether anæsthesia by Dr. Frank Sammis.

The usual straight lumbar incision was made with the arm extending forward along the crest of the ileum. The kidney was exposed and found to be densely adherent to the surrounding tissue, especially at its upper pole. The area at the junction of the middle third of the kidney showed marked evidences of destruction of the kidney tissue within the organ, and there was great danger of tearing off the upper pole of the kidney. With considerable difficulty the kidney was freed and its posterior surface brought up into the wound, the pelvic outlet exposed, the pelvis incised, and a large stone removed from the kidney pelvis without injury to the kidney tissue. The stone was as large as an English walnut. The opening in the pelvis was sutured with silverized catgut suture. Kidney replaced; cigarette drain to pelvis and rubber tissue to the lower pole. Wound closed around these drains. Patient stood the operation well. During the first 24 hours she passed about 45 ounces of urine.

Further History.—There was no leakage from the wound in the pelvis and the incision healed by primary union, excepting at the points where the drains led out. After the first five days of satisfactory post-operative course there were evidences of renal insufficiency. She developed a gastric type of uræmia evidenced by frequent uncontrollable vomiting and a gradually decreasing amount of urine excretion. This continued until death supervened twelve days after the operation. There were none of the ordinary evidences of uræmia other than the vomiting and the suppression of urine.

In considering the case afterwards we still felt justified in attempting some relief to the patient, although we were unsuccessful. In the first place, she was losing large quantities of blood and was suffering both from her frequency of urination and from pain. She was practically an invalid. At the same time the evidence which was presented showed us that both kidneys were very far below par, both in responding to the phenolphthalein test and the methylene blue test. After removal of the stone from the pelvis the reaction of the patient was all that could be asked. She felt well, passed a normal amount of urine, and was free from fever. However, after a few days the secretion of the kidneys failed and the patient died of renal insufficiency.

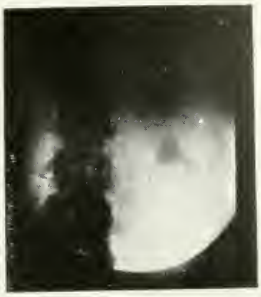
CASE III.—*Pelvis and calyces of left kidney filled by calculus material.*

Patient, aged sixty-one, referred to us by Dr. Heebe, of Brooklyn. For a number of years has had typical attacks of renal colic referred to the left side. About twelve years ago he passed a number of small calculi. In September, 1909, patient had an attack of tenesmus and a fairly large calculus became lodged in his urethra. This was removed through an endoscope. Since that time has suffered constantly from a bearing down pain in the bladder, especially when constipated. There has been soreness ever since, and patient has much backache over both kidney regions. Urine shows no albumin, some leucocytes and triple phosphates. Cystoscope shows chronic cystitis of the base of the bladder; no residual urine; urine as passed proved to be alkaline. Second examination made after treating the bladder, swelling disappeared and both ureter openings were found to be normal. No stones in the bladder. Urine showed a large amount of pus with fair amount of albumin and relatively numerous renal cells.

X-ray by Dr. Caldwell shows a very large collection of calculous material in the left kidney, which fills the pelvis of the ureter and has branches into six or eight calyces, most of which are enlarged. The kidney showed itself somewhat enlarged. The right kidney shows nothing unusual, except that it is weaker than the left.

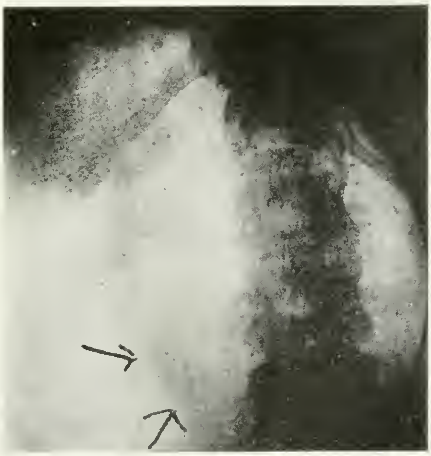
This case has not as yet been operated upon, and it is questionable whether the left kidney can be saved or not. The operation of pyelolithotomy is not to be thought of in this case on account of the extensive amount of calculous material filling the various calyces. The indication is to expose the kidney, remove the calculous material, and then determine the worth of the remaining kidney tissue. From the X-ray the pelvic outlet can be easily seen high up (Fig. 19).

FIG. 21.



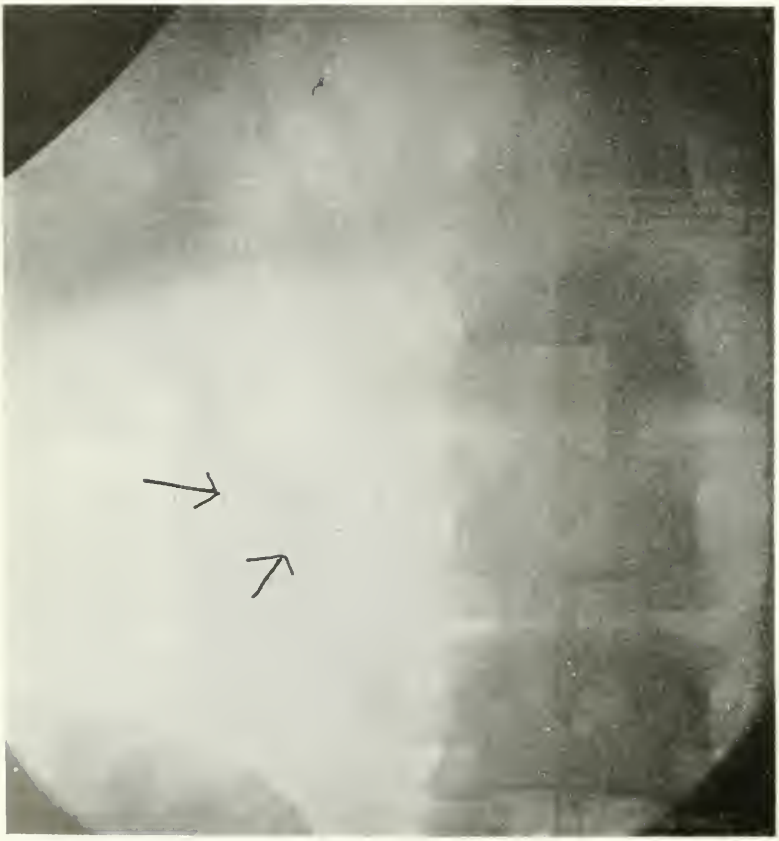
X-ray picture of the kidney region in Case V. It is seen that the calculus occupies the pelvic outlet and there is one small extension in the calyx. The stone is seen well below the last rib and is, therefore, easily accessible and was removed by pyelolithotomy with primary union in the wound.

FIG. 22.



X-ray picture of kidney region in a case of renal calculus in which all the symptoms of intense renal colic were referred to the right kidney. The cystoscopic findings showed the left kidney to be affected and an X-ray picture showed the calculus occupying the pelvic outlet in the left kidney. The X-ray shows the stone low down well below the free border of the ribs and therefore easily accessible and removable by pyelolithotomy. This was done and patient made an uninterrupted recovery from the wound.

FIG. 23.



Another case of calculus occupying the first portion of the ureter, the shadow showing it to be well below the free border of the ribs and therefore accessible to pyelolithotomy. This patient is yet to be operated upon.

CASE IV.—*Multiple calculi in right kidney, with pyonephrosis to a degree practically destroying the kidney; other kidney sound; nephrectomy.*

A young woman who had suffered from intermittent attacks of renal colic on the right side, at which times there would be fever, pain, and general prostration. History dates back to the birth of her child three years previously. The cystoscope showed large amount of pus coming from the right kidney. The left kidney was normal. When the right kidney was exposed it was found to be a mere shell containing numerous calculi. The indication in this case was for nephrectomy without question (Fig. 20).

CASE V.—*Single calculus in the pelvis of the right kidney; left kidney sound; calculus removed by pyelolithotomy.*

A woman about twenty-eight years of age. Four years ago was operated upon for supposed appendicitis on account of indefinite pains in the right side. The appendix was removed, but the trouble still persisted. One year ago urine showed a large amount of albumin during pregnancy. Some pus in the urine, which has never cleared up. She has had very considerable bladder irritability, with frequency of urination. Chief complaint now is bladder irritability with urine containing pus and blood. Pathological examination showed pure culture of Streptococcus albus. Bladder urine showed pus, oxalate of lime, and a few red blood-cells. Further questioning elicited the history that she has suffered from so-called attacks of indigestion which centre in the right side in the region of the right kidney.

Cystoscopic examination showed congestion of the bladder. Both ureter openings normal, with some congestion near the right ureter opening. Catheterized urine from the right kidney very profuse and watery, contained pus. Catheterized specimen from left kidney perfectly clear, very profuse. Both kidneys very excited.

X-ray examination showed a sheath-shaped calculus in the pelvis of the right kidney (Fig. 21). Its size and position on the X-ray plate showed that it was an ideal case for pyelolithotomy. The stone was removed at the Long Island College Hospital by pyelolithotomy. Patient made an uninterrupted recovery.

TRANSPERITONEAL RESECTION OF A DIVERTICULUM OF THE BLADDER.

BY EDWIN BEER, M.D.,

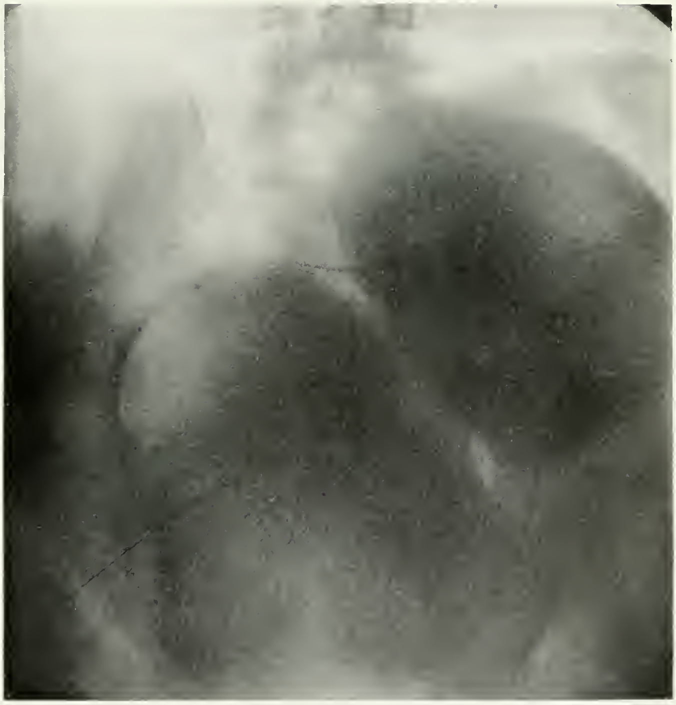
OF NEW YORK.

From the Genito-Urinary Surgical Service of the Mount Sinai Hospital.

According to the excellent review of Wm. Lerche, in the Annals of Surgery, lv, 285, 1912, there are only 15 cases of excision of diverticula of the bladder recorded up to that date. Since then four more cases have been added during the current year, two by Chute, one by Bergener and one by Bryan. Of all these cases only four were approached by the intraperitoneal route, and most of these in a somewhat different manner from that employed in the case to be reported. The favorite method of approach has been the extraperitoneal route, pushing the peritoneum back from the bladder, and then cutting off the diverticulum or invaginating it into the bladder and then cutting it off through an opening in this viscus. To these four cases I wish to add a fifth, in which I was able to remove by the transperitoneal route without any great difficulty, perhaps the largest diverticulum that has been removed, and which went on to recovery without any accidents. As the method used in this case has some advantages, due to the better exposure and the more ready access, I have deemed it advisable to report it *in extenso*.

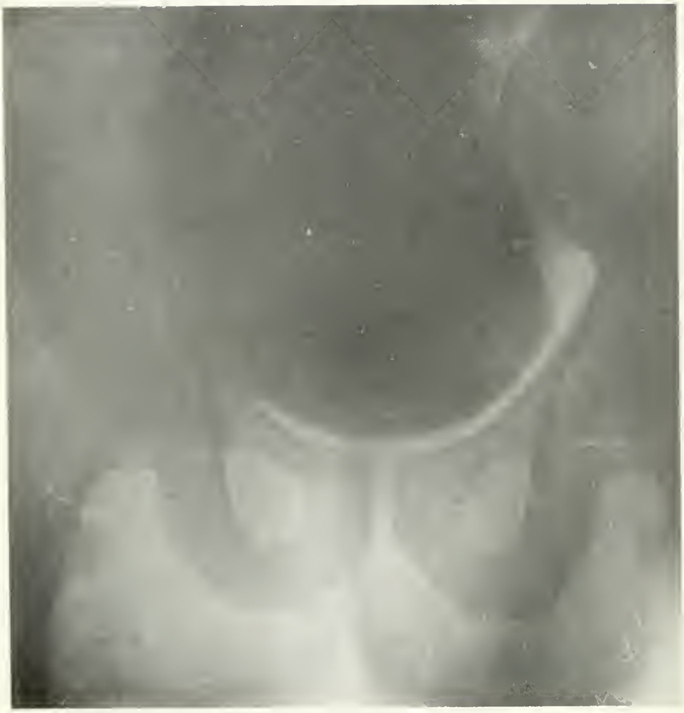
Case I.—Male, thirty-five years. Well until ten months before admission to the hospital. At that time he says he caught cold, following which he had a urethritis. Discharge from urethra lasted four weeks, but the urine continued cloudy, and showed a sediment on standing. It had a foul odor. There was no dysuria, no hæmaturia, and no increased frequency. Seven months later he developed a swollen testicle on the right side. This lasted two weeks, and then disappeared. Three weeks before admission this testicle again became swollen. Throughout this time the urine remained as above.

Fig. 1.



Diverticulum of bladder. X-ray with collargol. Before excision.

Fig. 2.



Diverticulum of bladder. X-ray with collargol. After excision.

On admission the patient showed an undue pallor and a general lack of tone, probably due to the toxic absorption from his urinary tract. His physical examination showed no organic or nervous disturbance. The right testis was somewhat larger than the left, and there was a small nodule in the right epididymis.

There was slight tenderness in the right costovertebral angle. Cystoscopic examination showed just behind the right ureter meatus, which was normal though displaced toward the neck of the bladder, a large diverticular opening, into which the cystoscope entered readily. The interior of this cavity was easily inspected, and its mucosa found to be inflamed, and covered with pus, especially in the dependent parts. Just mesial to the orifice of the diverticulum and behind the interureteric line there were two small crypts, which just admitted a catheter, but from which no stream was emitted. The left ureter meatus was normal in appearance, and just behind it and a little to the left there was another small diverticulum, situated in the same relative position as the enormous one on the right side. The trigone was very much inflamed. No third ureter could be found. After careful washing, the ureters were catheterized and clear urine obtained from the left, but slightly turbid (pus) urine from the right. Indigo carmine was excreted in good concentration from both sides in 20 minutes.

From the foul smelling urine only colon bacilli were recovered. The residual urine varied from 20–26 ounces, and the bladder capacity was 42 ounces. When the bladder was well filled it extended up to the umbilicus, and the examining finger could detect the filled diverticulum spread out in the region of Douglas's pouch, more on the right side than on the left. X-ray pictures with collargol (see Figs. 1 and 2) showed a pouch alongside and cephalad to the bladder of about the same size as that organ and about 5–6 inches in diameter.

As treatment by irrigation did not effect any improvement, and as the right kidney already showed signs of disease due to pressure of the diverticulum on the corresponding ureter, it was decided to operate on the patient and effect, if possible, a radical cure. The fact that the mortality in these cases, if neglected, is very high influenced me in my decision.

Operation.—Transperitoneal excision of the diverticulum.

Suture of the bladder wall and drainage of the retroperitoneal space by marsupialization with a tube.

To assist in the recognition of the right ureter, a catheter was introduced into this, and to allow of filling or emptying the bladder another catheter was placed in this organ. After thorough washing of the bladder, a 5-inch median laparotomy was made with the patient in Trendelenberg. The collapsed diverticulum was difficult to recognize and impossible to define. After filling the bladder with solution its shape and limits could be made out. It was then seen to be in part intraperitoneal, but the major part was extraperitoneal, in close relation with the structures of the pelvis. The whole wound was carefully protected (bladder empty again), and the neck of the sac which admitted three fingers, was cut down upon. The peritoneum and subperitoneal fat was cut through and the muscular wall of the sac reached. The sac was slowly dissected free from its overlying peritoneum, and no serious difficulty encountered until the more dependent parts were reached, where the diverticulum was found to be very adherent. The ureter was easily identified, and found directly in contact with the diverticulum and enlarged, permitting the catheter to move freely from side to side within its lumen. There was very little bleeding in this enucleation, and accidentally the diverticulum was torn into in the inflamed and adherent part. Clamps were placed on the bladder and the liberated part of the diverticulum, and the bridge was cut, and surfaces carbolized. Then the freed part of the diverticulum was cut away, and an attempt made to invaginate the small adherent piece that remained in the depth of the pelvis. This invagination was impossible and the remaining piece of diverticulum was removed by dissection from the deeper pelvic structures, the ureter, vas and vesicle. This was accomplished without any injuries, and then the bladder was closed in layers. The deep layer took in the mucosa and muscularis, and was of catgut, while Pagenstecher was used for the peritoneo-muscular suture. The large hole left in the retroperitoneal space was sutured in great part, and into the opening left a tube was placed. The edges of the peritoneum about this drainage tube were sutured to the parietal peritoneum close to the bladder, thus marsupializing the retroperitoneal space. The wound was closed in layers, and a permanent catheter left in the bladder.

The patient left the table in good condition. Very little blood had been lost, and no fluid had escaped from the bladder or the diverticulum into the operating field.

The patient made an uneventful recovery. The permanent catheter was removed on the tenth day and the patient voided spontaneously 6–10 ounces at a time. Two days later the tube into the retroperitoneal space was removed and this tract healed rapidly. Twenty-six days after operation patient was discharged cured.

The pathological examination shows an inflamed fibromuscular sac wall with a lining of epithelium of the transitional type. In most of the sections the epithelial lining is absent. (Dr. F. S. Mandelbaum.)

The patient continues well, without any symptoms referable to his bladder. His residual urine is 1.5–2 ounces.

Remarks.—The case just described in some detail represents a typical case of diverticulum of the bladder. If one may judge from the structure of its walls, it was a congenital pouch and this is all the more likely as there was no obstruction in the outflow channel to lead to a secondary or acquired diverticulum. As is quite usual in these cases the diverticulum gave no symptoms until it became infected and then despite local treatment the cystitis and diverticulitis continued uninfluenced. If we can place any reliance on the statistical data contained in the literature, this patient would have gone from bad to worse and his kidneys would have become seriously infected (*vide* Englisch, who says that the mortality in such cases is 83 per cent.). After repeated washings of the bladder the diverticulum was approached transperitoneally, so as to give the best view of the condition and to render it easiest to deal with any adhesion that might have developed. The approach was an excellent one, and the operation was much simpler than I had expected. After removing this large sac the equally large retroperitoneal space in which it had rested had to be dealt with, and as this area might very readily have been contaminated, I decided to drain this space by marsupialization, bringing the opening into this space out to the parietal peritoneum, close above the bladder, so that no band formation could take place between this and the posterior parietes and thus lead to a possible subsequent ileus. The close approximation of the redundant posterior parietal peritoneum to the bladder wall and the very small or shallow shelf thus produced, was, I believe, rapidly obliterated by adhesion to the suture line, which was also effectively protected in this way. The post-operative recovery was very satisfactory and the patient voided within twelve days sixteen ounces at one time. With the removal of this pouch the urine became much clearer and the patient began to pick up, so that within three months he felt perfectly well.

REPORT OF 105 CASES OF STRANGULATED HERNIA.*

BY EMORY G. ALEXANDER, M.D.,

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Associate Surgeon to the Episcopal Hospital.

THE 105 cases of strangulated inguinal, femoral, and umbilical hernia herewith reported were operated upon at the Episcopal Hospital within the past six years. Covering as it does quite a large number of cases, and the work of several years, an analysis of these cases, I thought, might prove of interest to the Academy.

It is strange that in the past two decades of progressive surgery, in an era unparalleled by the great strides made in the art of diagnosis, operative technic, and after-treatment, to say nothing of the help obtained by educating the public to surgical conditions, that little has been done, either directly or indirectly, to lower the death rate of this condition.

The onward march of surgery has been from the pelvis upward, until that great divide, the diaphragm, was reached. This obstruction has caused a momentary halt in the advancement of visceral surgery, although a few have crossed over and invaded the thoracic cavity. During this momentary lull in visceral surgery some few have turned back to the old things that were long considered a dead issue. We have but to recall to mind the magnificent work of Lane and Murphy on bones and joints to realize that this momentary pause has been a blessing in disguise. Let us hope that others will turn back to the " dead issue " and that strangulated hernia will be considered.

The mortality of strangulated hernia remains to-day what it was ten or even twenty years ago. It is, unrelieved, an acute progressive abdominal condition, and the mortality will

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* Read before the Philadelphia Academy of Surgery, May 5, 1913.

STATISTICS.

Inguinal Hernia

Right			Left		
Male	34	Rec.	Male	6	Rec.
Female	3		Female	1	
Male	10	Died	Male	2	Died
Female	3		Female	1	

Recovered 44, died 16, not operated (died) 3, total......63.

Femoral Hernia

Right			Left		
Male	0	Rec.	Male	1	Rec.
Female	12		Female	5	
Male	1	Died	Male	0	Died
Female	4		Female	2	

Recovered 18, died 7, not operated (died) 2, total......27.

Umbilical Hernia

Right			Left		
Male	3	Rec.	Male	1	Died
Female	8		Female	8	

Recovered 11, died 9, not operated (died) 1, total......21.

Ages of Patients.

Age.	Inguinal.		Femoral.		Umbilical.		Mortality.
	Rec.	Died.	Rec.	Died.	Rec.	Died.	
1–10	5	1	..	..	..	..	16 per cent.
10–20	4	1	1	..	..	..	16 per cent.
20–30	8	0	4	..	..	..	0 per cent.
30–40	8	3	3	2	3	1	30 per cent.
40–50	7	3	4	2	3	3	36 per cent.
50–60	3	4	3	1	4	3	44 per cent.
60–70	8	2	1	1	1	2	33 per cent.
70–80	1	2	2	1	..	..	50 per cent.
Total..	44	16	18	7	11	9	

Number of Hours Strangulated.

Hours.	Inguinal.		Femoral.		Umbilical.		Mortality.
	Rec.	Died.	Rec.	Died.	Rec.	Died.	
1–12	21	1	7	0	4	1	5 per cent.
12–24	17	7	8	2	5	3	28 per cent.
24–48	3	2	2	2	2	1	41 per cent.
48–	3	6	1	3	0	4	76 per cent.
Total..	44	16	18	7	11	9	

Mortality

Inguinal	Per cent.	Femoral	Per cent.	Umbilical	Per cent.
Right inguinal, male,	22	Right femoral, male	100		
Left inguinal, male,	24	Left femoral, male,	0		
Right inguinal, female,	50	Right femoral, female,	25		
Left inguinal, female,	50	Left femoral, female,	28		
Inguinal mortality:		Femoral mortality:		Umbilical mortality:	
Male	23	Male	50	Male	25
Female	50	Female	26	Female	50
Total inguinal mortality: Male and female	26	Total femoral mortality: Male and female	28	Total umbilical mortality: Male and female	.45

Total Mortality

Male	24 per cent.
Female	38 per cent.
Male and female	30 per cent.

continue to remain unchanged until the profession and public, as in appendicitis, and as we are trying to do in cancer, become better educated to the fact that an early operation and the avoidance of taxis in hernias are the two most important factors in lessening the mortality.

Unfortunately, we cannot in strangulated hernia as in appendicitis with peritonitis, "dry dock our patient for repairs," and hope for an abeyance of the symptoms, and after localization of the inflammatory process, a successful operation and ultimate recovery of the patient.

Of the 105 cases of strangulated hernia, 58 were males and 47 were females. Sixty were inguinal, 25 femoral, and 20 umbilical. During this period of six years 848 cases of hernia of the above types were operated upon at the Episcopal Hospital. Three of this number were strangulated. Six cases of strangulated hernia were admitted to the hospital in a moribund condition and no operation was attempted.

The great majority of these cases of strangulated hernia gave the usual history of having had the hernia for years and of wearing an ill-fitting truss. The symptoms varied. Among the most constant were sharp pains at the hernial orifice, colicky pains, nausea and vomiting. So constant were the last three symptoms mentioned, paroxysmal pain, nausea and vomiting, that when not reported on the histories, I believed their absence due to an error on the part of the history taker in failing to record them. In almost every instance taxis had been tried by the patient and also by the attending physician.

The ages of the patients ranged from six weeks, the youngest, to eighty years, the oldest; and the duration of the hernia, non-strangulated, from two weeks to sixty years.

The condition of the patients on admission to the hospital varied, depending almost entirely upon the degree and length of time the hernia had been strangulated. The cases admitted in shock, with a subnormal temperature, fast pulse, etc., showed the highest mortality.

The diagnosis is usually easy. Only in one or two instances were the patients referred to us with an incorrect diagnosis, and these were either in small femoral hernias, or in inguinal hernias in which the attending physician recognizing a surgical condition had failed to make a thorough examination. In two instances the condition was mistaken for an appendicitis with diffuse peritonitis.

In any patient giving a history of a hernia coming down and not being able to reduce it, or an irreducible hernia becoming larger and more tense, and if either condition is followed by pain at the hernial orifice, colicky pain, nausea, and vomiting, a strangulated hernia should immediately be thought of. Speculations as to whether the hernia is irreducible, obstructed, inflamed or strangulated, depending on the passage of flatus, percussion sound, or the presence or absence of peristalsis in the hernial sac are misleading and the delay in waiting for such symptoms jeopardizes the life of the patient. The redness of the skin and the exquisite tenderness of the hernia, I believe, is often due to local applications, and too prolonged or vigorous taxis.

One often wonders, after operating on a case and seeing the hernial sac full of blood, and the bruised and injured condition of the intestine, if it would not have been better, certainly since the perfection of hernial surgery, if our medical schools would cease to teach the practice of taxis except in a few limited instances. Taxis, like all good things, is often overdone. It no doubt saves many from being operated upon, and in instances when surgical aid is unobtainable, is frequently a life-saving device. It, nevertheless, causes the death of many. Certainly, in a large percentage of the cases in this series, can the mortality be attributed to the delay caused by taxis.

Simple taxis, or taxis aided by an anæsthetic, morphine injection, local application, hot bath, elevation of the foot of the bed, etc., often prolongs for hours or days the question of operative interference. So important was the question of taxis, and so dangerous its use, that the old surgeons tried to place a limit of time, varying from a few minutes to two hours, during which it was safe to persist in its use. Coley does not think it wise to continue taxis for more than five minutes. The same author believes that taxis should never be attempted in those cases " in which the symptoms of strangulation have been exceedingly severe from the start," in those " in which strangulation has occurred in previously irreducible hernias," and in cases " in which 24 hours have elapsed after strangulation."

The preparation of the patient for operation should be the same as for the usual emergency case. If the patient is vomiting, and especially if the vomitus is fecal in character, the stomach should be washed out. It is believed that the washing out of the stomach of these cases lessens the chance of an aspiration pneumonia, especially if ether be the anæsthetic.

The anæsthetic used depends largely upon the operator, the condition of the patient, and the technic to be employed. In the above cases, ether, chloroform, local and spinal anæsthesia were used.

Ether, I believe, in the majority of instances, is the anæsthetic of choice, and if used, should be preceded, in the cases with fecal vomiting, by washing out the stomach.

Chloroform has a very limited use, but occasionally can be used advantageously in cases with kidney or lung complications.

Local anæsthesia is of advantage in cases complicated by cardiorenal and lung conditions. The increased length of time required to perform the operation under this anæsthesia, and the mental shock often accompanying it, are its chief disadvantages.

Spinal anæsthesia has a very limited use. I believe it to be a dangerous anæsthetic, even in the hands of the most expert, and certainly should be used cautiously in the aged and in cases of long duration.

Unless absolutely contra-indicated ether is certainly the anæsthetic of choice, and from the deaths recorded in this series, is not complicated by pneumonia or uræmia any more frequently than any of the other anæsthetics mentioned.

The operation performed must relieve the constriction, and if the gut is not gangrenous, return it to the abdominal cavity. If the gut is not viable, and that often is a very hard question to decide, one of the following procedures must be adopted.

If it is a border line condition and you are unable to decide whether the gut is gangrenous or not, it can be left in the wound for 12 to 24 hours until all doubt has passed.

If the gut shows a small gangrenous area we have been quite successful by invaginating this spot. If a large gangrenous area is encountered this portion of the gut must be resected and either a lateral or end-to-end anastomosis performed, the latter preferred, or an artificial anus can be established. Our statistics favor the resection method. In either instance the cases are most unfavorable and the mortality is very high.

One of the most remarkable recoveries in this series was in a woman, 50 years of age, with a hernia of the femoral variety involving the small intestine, which had been strangulated for four days. An artificial anus was established, which later healed spontaneously.

In strangulated hernias of the so-called Richter type, or partial enterocele, either femoral or inguinal, the mortality is high. This is probably due to the fact that these hernias are small, are often overlooked, and consequently come to the surgeon late. In this type, on three occasions, the hernia reduced itself while the patient was being anæsthetized. In the first case, a herniorrhaphy was performed without exploring the gut; the patient died in two days of a diffuse peritonitis and the autopsy showed a perforated gangrenous area the size of a penny. In the other two cases, at the time of operation, the gut was caught and pulled down into the wound, thus ascertaining the true condition of affairs.

The hernias that reduce themselves while the patient is taking an anæsthetic, especially if the strangulation is of several hours' duration, and the gastro-intestinal symptoms have been marked, should be operated upon, as the true condition of the gut should be ascertained. One of the umbilical hernias in this series reduced itself while the patient was being anæsthetized, no operation was performed. The patient died a day or so later and the autopsy showed a volvulus of the ascending colon.

In the majority of instances of strangulated hernia there is little doubt as to the viability or not of the intestine. In some cases, however, the decision would tax the judgment of the most expert. The best test for the viability of the intestine is the application of compresses wrung out in hot saline solution, although help can be obtained by noting the loss or not of the glossy appearance, whether the gut is dull and granular, whether its color is red, purple, black, grayish or mottled, and also if the gut is firm and elastic or soft, flabby and collapsible.

Kocher lays great stress on the pulsation of the vessels of the mesentery and bowel.

If resection is to be done the excision should go wide of the gangrenous area, especially is it important to do so to the proximal side and get beyond the distended and water-logged portion into healthy bowel.

In all cases operated upon the ideal operation is a herniotomy and herniorrhaphy. Unfortunately, this is not possible in some, as the physical condition of the patient may only warrant the relief of the constriction. In large scrotal and umbilical hernias, on account of the many and dense adhesions, it is often best to simply relieve the constriction. Especially is this true if the patient's condition does not warrant a prolonged operation.

In this series 32 cases died. The cause of death was as follows: Peritonitis, 11; uræmia, 3; pneumonia, 4; shock, 5; myocarditis, 2; delirium tremens, 2; apoplexy, 2; acute dilatation of heart, 1; volvulus, 1; sarcomatosis, 1. The five cases that died of shock were desperate ones and really should be classed under deaths due to peritonitis.

The prognosis depends almost entirely upon the degree and length of time the hernia has been strangulated and the resisting power of the patient.

The type of hernia, the sex and the age seems to have some bearing on the mortality. The death rate is lowest in children and highest in the aged. The mortality is higher in femoral than in inguinal and is highest in the umbilical.

The reduction of the mortality of strangulated hernia, as stated earlier in this paper, depends upon the education of the public and shall I say, profession, to the importance of early operation and the avoidance of prolonged and vigorous taxis.

The prevention of strangulated hernia is likewise an educational one. By educating the public to the danger of a simple hernia becoming strangulated, and the importance of having the hernia operated upon, or if operative treatment be refused, the wearing, under the supervision of a physician, a properly fitting truss will reduce the number of this almost inexcusable condition.

In closing, I wish to make a plea that all simple hernias in children, and especially those of the scrotal type, be operated upon. I believe it is wrong to order a truss for these cases, when we know the percentage of cures is very small. If a radical cure be performed in these cases, we have taken a great step toward the prevention of strangulated hernia.

IMMEDIATE AND LATE RESULTS OF THE WHITEHEAD OPERATION FOR HEMORRHOIDS.

A REVIEW OF 470 CASES.

BY HARVEY B. STONE, M.D.,
OF BALTIMORE, MD.

Almost since the description by Whitehead of the operation for hemorrhoids which bears his name, there has been animated controversy as to the merits and demerits of the procedure. Among the acquaintances of the writer there are many men, particularly rectal specialists, who highly disapprove of the Whitehead operation. On the other hand, many general surgeons of the highest attainments, whose opinion certainly should carry much weight, employ practically no other method in the treatment of piles, maintaining that if the operation be properly performed it is not likely to be followed by unfortunate consequences. The material accumulated at the Johns Hopkins Hospital afforded excellent opportunity to study the results of the Whitehead operation, as this has been the method of choice on the surgical service, since the hospital was opened, twenty-four years ago. With the kind permission of Dr. Halsted, the writer has undertaken to follow the subsequent history of the Johns Hopkins Hospital cases from 1889, when the work began, until 1910, when this review was undertaken. In addition to these cases, those operated on by Dr. J. M. T. Finney at the Union Protestant Infirmary have been investigated and included in this report. I wish to express to Dr. Halsted and to Dr. Finney my great appreciation of this privilege.

The unique feature of this article and the one which, perhaps, best justifies its publication, is the fact that the 470 Whitehead operations which are herein reported were performed by 45 surgeons, young internes for the most part, and some of them in the first year of their hospital service. Hence it may be assumed that the results obtained in this series of cases are not much better than might be expected at the hand of the average surgeon.

In surveying the literature I have given no consideration to the many papers describing minor modifications in the technic of applying the Whitehead principle nor to the numerous articles reporting one or two unfortunate results following attempts at the Whitehead operation. Whitehead[1] himself, in 1887, published a series of 300 cases which he had operated on by the circular method. Omitting particulars, he makes the simple statement that there were no deaths and no post-operative complications, such as hemorrhage, ulceration, abscess, stricture or incontinence. This paper was in the nature of a reply to critics and is less convincing than it might have been had the cases been reported in greater detail.

Yukelson[2] published a paper in Russian, the title of which translated is "Three Hundred and Thirteen Operations for Hemorrhoids by the Whitehead-Veresco Method." Unfortunately this article has not been accessible, and cannot be reviewed.

W. Graeme Anderson[3] in 1909, published a study of the after results of 300 hemorrhoid operations. Of these 150 were operated by the ligature, 100 by the Whitehead method, and 50 by the clamp and cautery.

By Anderson the Whitehead method was considered the most painful and the cautery the least painful; the catheter was necessary in 10 per cent. of the ligature cases, in 6 per cent. of the Whitehead cases, and in none of the clamp and cautery cases; the return of sphincter control was earliest after the cautery and latest after the Whitehead operation. There seemed to be a greater tendency to stricture after Whitehead operations than after the others, especially when the area healed by granulation was large. The statement is made that no Whitehead case healed by first intention; that skin tags were least often found after the Whitehead and most frequently after the use of the ligature. There were no recurrences within six weeks in any of the cases. Post-operative hemorrhage occurred after ligation in four cases, after the Whitehead operation in two cases, and in no case after the cautery. Very few of these cases were observed for more than a year.

In 1910, Takaki[4] reported briefly 176 cases. There were three strictures, two ulcers, and one death (from pulmonary embolus) in this series, but no note is made as to how many of the cases were observed after operation, nor for what period of time. One instance of paralysis of the sphincter is also noted, but with the statement that this condition existed before operation and was not a consequence of it.

O'Conor,[5] in the same year, describing minor variations in the technic as practised in his clinic, incidentally records 490 cases successfully operated on by the Whitehead method, but with no specific details as to post-operative study of the patients.

While the present paper was being written, Hadda[6] published a paper dealing with the same subject his material embracing 223 cases, of which 127 were seen or heard from afterward, some of them after the lapse of 7 years. Among these patients there were three post-operative hemorrhages and one death, the latter attributed to scopolamine poisoning from idiosyncrasy. 155 cases required catheterization, and in 104 of these cases it was necessary beyond the first day. Of the 27 cases examined, three had small skin tags, one a small prolapse of mucosa, and one a small ulcer of the mucosa. Among the cases replying by letter, one complained of "weakness" and pain in the rectum, one of the persistence of a sigmoiditis antedating operation, and a third of slight stenosis. The others reported themselves as satisfied with the results obtained.

Besides these articles there are several dealing with a much smaller group of cases. Martin,[7] Veron,[8] Labaume,[9] and McGlannan[10] report series of from eleven to thirty-nine cases, all with good immediate results. But very few of the patients were observed for more than a few months.

I was rather surprised to find that in my collection there were no deaths, nor are there any notes as to the occurrence of anæsthesia disturbances, such as pneumonia and bronchitis. The absence of pulmonary complications may be due, at least in part, to the position of the patient on the operating table (head low and high buttocks), which prevented the gravitation of mucus, etc., into the respiratory tract. In many of the cases there were pre-operative complications. Thus in eight there was fistula, three were neurasthenics, and three suffered with fissure, two had rectal ulcer, two hernia and two polypi; others suffered from amœbic dysentery, chronic prostatitis, enlarged prostate, pilonidal sinus, lues, severe secondary anæmia and urethritis.

Among the post-operative complications are the following: in one case a hæmatoma which became infected; in four cases post-operative hemorrhage; in six cases there was infection of the suture line which caused a local abscess; post-operative ischiorectal abscess was observed once; in two cases there was post-operative fecal impaction, and in one of these chloroform was required for its relief. In most cases a lead and opium pill containing 1 grain of opium was given three times a day, for the first three or four days. In addition to this most cases required one or two doses of morphia (gr. one-eighth) hypodermically. In a few cases much larger amounts were required—as much as 3 grains of morphia in one case which was complicated by an extensive infection. In not all instances was a note made as to the necessity for catheterization; but memoranda as follows were obtained: catheter not used, 36 cases; used once, 43 cases; used twice, 15 cases; used three times, 20 cases; used more than three times, 42 cases. In one case the patient had to be catheterized for twelve days after operation. As to the condition of the wound at the time of the patient's discharge from the hospital, it was noted that there was a granulating surface of greater or less extent in 116 cases. The average time of detention in the hospital after operation in the first years of this series was about fourteen days; this has been reduced to about ten days in the later years.

To obtain the subsequent history of the cases treated by the Whitehead operation has been the chief purpose of this investigation. To secure data on this point a questionnaire was sent to each patient with specific interrogations, and a request for an examination if possible. As a result we have seen or heard from 185 cases. Of this number 31 have been operated on less than five years, 59 from five to ten years, 58 from ten to fifteen years and 37 from fifteen to twenty-two years. From the answers received and from examination of the cases, I conclude that the results were perfect in every respect in 134 cases, a percentage of 72.4. The most frequent complaint was disturbance of the sphincter action. This complaint was variously phrased; " weakness of control of the bowel " or " imperfect control " were common expressions, and in many cases the statement was made by the patient that he experienced inconvenience in this respect only when from medication or indiscretion in diet there resulted an attack of diarrhœa. There were 37 cases in which the muscular control was more or less impaired but in only one of these was there actual paralysis of the sphincter. It should be noted that this patient developed hemiplegia five years after his operation, hence it is not clear that the Whitehead operation was alone responsible for the paralysis of the sphincter. Of these 37 patients there were eight who complained of itching or moisture following the operation, but in most of them this was a temporary condition.

It will be seen that, except in the case of the hemiplegic, there was no instance of serious incontinence in the whole series. In this connection it should be remembered that where large prolapsing hemorrhoids have existed for years the sphincter is no doubt flaccid and weakened before operation.

A number of patients wrote that they had been bothered for five or six months by sensory disturbances. In 16 the itching and moisture is still complained of by the patient. In many instances the annoyance was said to be " slight."

In 5 cases there is a certain degree of stricture. Two of these were examined by the writer personally. One of them did not know that he had a stricture; in him there was found a narrow wire-like ring of fibrous tissue of wide calibre which easily admitted the index finger and caused no symptoms. In 14 cases a recurrence in some measure had taken place. One of these patients wrote that for 19 years he had had a perfect result, and then developed a thrombotic external pile. Another states that he had two small skin tags remaining from the operation. A third that he has a small external pile. Another merely says that there is still "some bleeding." Four others have what they describe as a "little return" of the piles. One patient, in response to letters, returned to the hospital, was re-admitted, and operated upon for an isolated hemorrhoidal polyp, which had developed since his original operation. In five cases there was more or less extensive recurrence of the hemorrhoids and of these, three were operated upon the second time. Upon one of the three a third operation was made, each of the operations being performed by a different surgeon and by a different method. This patient states that he still suffers from hemorrhoids.

Conclusion.—The Whitehead operation should not be considered a formidable procedure nor one which results "commonly in incontinence and stricture," as is frequently stated. It does not absolutely and forever preclude the return of varicosities, as some of its advocates claim that it does. A definite indication for its employment is the existence of a rosette or complete circle of varicosities. The simple cases presenting one or several isolated hemorrhoids may not require the Whitehead operation for their relief, but the minor procedures are not so thorough and seem less likely to result in a radical cure.

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[2] Yukelson: Khirurgia, Mosk., 1909.
[3] Anderson, W. G.: British Med. Journ., 1909, ii, 1276.
[4] Takaki: Lancet, 1910, i, 929.
[5] O'Conor: Lancet, 1910, ii, 946.
[6] Hadda: Archiv. f. Klin. Chir., 1913, vol. c, 1029.
[7] Martin, Achille: Thesis, Paris.
[8] Veron, Felix: Thesis, Paris.
[9] Labaume, Joseph: Thesis, Paris.
[10] McGlannan, A.: Old Dominion Journ. of Med. and Surg., 1911, xii.

A METHOD FOR THE MECHANICAL FIXATION OF TRANSVERSE FRACTURES.

BY H. S. SOUTTAR, F.R.C.S.,

OF LONDON.

Assistant Surgeon, West London Hospital; Surgical Registrar, London Hospital.

This method has been devised with a view to obtaining a more accurate and substantial fixation in transverse fractures of the femur and humerus especially, than has hitherto been possible. The plate used is of thin sheet steel and instead of lying upon the surface of the bone is for the most part buried in its substance. For this purpose a slot is cut longitudinally in the two fragments of the bone with a small circular saw.

The plate is 1 cm. or more wide and from 5 to 10 cm. in length. The whole of this portion is intended to be buried in the bone. A narrow flange projects from one edge and is to lie on the surface of the bone. This flange may be provided with holes for screws. In other cases it may be preferred to fix it with wires encircling the bone.

The saw is 4 cm. in diameter and is provided with a substantial handle and a guard. It can be boiled entire, it can be readily taken apart, and it can be adapted to any form of motor. The teeth are so constructed that they do not tend to catch in the bone though they cut with great freedom. The appliance is extremely easy and safe to use.

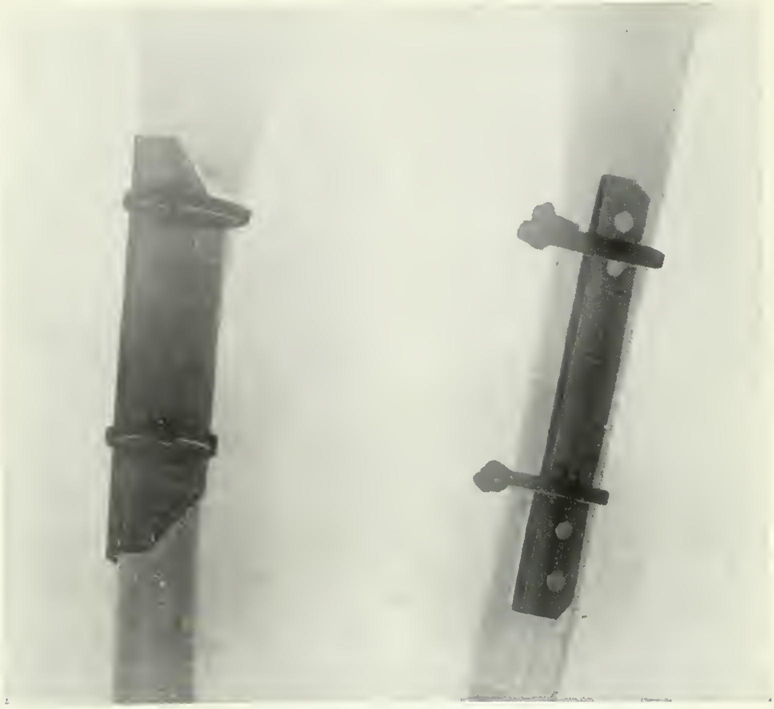
In most cases screws will be preferred and a special form of screw is provided. They are of steel with a fine thread, as they are intended to engage only in the compact bone. The point is slightly tapered and this portion of the screw is flattened on one side. A sharp edge is thus left by means of which the thread actually cuts its way into the dense bone. The screw may thus be driven into the bone with great freedom and scarcely any resistance is encountered till it is actually home. A solid hold is thus obtained which is impossible with other types.

An incision is carried down to the bone and the two fragments are manipulated into line. In a case of transverse fracture it will usually be possible to make the jagged ends engage. The fragments are held firmly in line by an assistant and with the circular saw a slot of sufficient length is cut in the long axis of the bone, care being taken that it is accurately at right angles to the surface. With the special saw it will be found that this is quite easy and that even in deep wounds the flaps do not seriously interfere, the guards on the saw pushing them out of the way. Immediately the slot has been cut the plate is inserted. Screw holes are drilled, the tapered ends of the screws are inserted and the screws are driven home. The taper enables the screw to support itself while the driver is applied. An occasional backward turn of the driver will clear the thread of the screw and enable it to cut more cleanly. If it is preferred, wires encircling the bone may be used instead of screws.

The chief advantage of this method is the great solidity of the fixation. In the case of a fracture of the femur it is quite practicable to get the patient out of bed on the next day should his condition demand it, and passive movements of the joints may in all cases be begun at once. Splints are quite unnecessary and in fact harmful as they tend to interfere with the efficient circulation which is so essential to repair. The girder form of the plate allows it to be made of thin material without impairing its strength. Only a small portion of the plate appears on the surface of the bone and the heads of the screws are rounded so as to fit snugly up against it. There is thus very little projection on the surface and no interference with muscular action. The existence of the plate inside the bone seems to give rise to no trouble. It is probable that in most cases the whole plate is soon buried in callus.

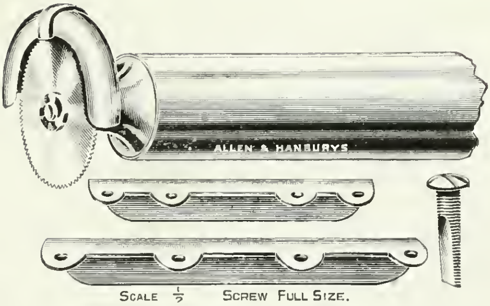
Though the method is not adapted to many forms of fracture it appears to meet admirably the requirements of the two for which it was specially designed, namely, transverse fractures of the femur and humerus about the middle of the

Fig. 1.



Plates applied to femur.

Fig. 2.



Souttar's saw and plates.

shaft. The value of a method which ensures immediate and absolute fixation and which dispenses entirely with splints in these important and somewhat difficult cases will probably be appreciated.

The accompanying plates (Figs. 1 and 2) show the saw, screws and plate, and the method as applied to the femur of a boy of twelve years whose fracture had failed to unite by the ordinary methods. The operation in this case was carried out by Mr. Milne, of the London Hospital. The boy walked at the end of three weeks and when seen two months after the operation presented a result functionally perfect.

The plates, screws and saw have been made to my designs by Messrs. Allen & Hanburys from whom they may be obtained.

A FURTHER NOTE ON REDUCTION OF FRAGMENTS IN FRACTURES OF THE LONG BONES AT OPEN OPERATION.

BY JOHN C. A. GERSTER, M.D.,

OF NEW YORK.

Adjunct Surgeon to Mount Sinai Hospital; Assistant Surgeon to City and to Knickerbocker Hospitals.

Some months ago I described a method for distracting the overlapping fragments of a fractured long bone by means of a turnbuckle placed between two Lowman clamps,[1] one on each fragment (Fig. 1). As the turnbuckle forces the clamps apart, the resistance of the soft parts increases. This resistance is chiefly noticeable on the side of the bone opposite to where the turnbuckle is applied. The tendency is for the fragments to kink (Fig. 1), and for the shafts of the Lowman clamps to diverge instead of remaining parallel. If the divergence is at all marked, the turnbuckle's jaws slip up the shafts and slide out of place. To prevent this occurrence it is necessary *a,* to place the turnbuckle as close down to the bone as possible; *b,* to keep the two clamps parallel to one another by means of an assistant's hand which grasps both milled heads of the Lowman clamps, one with the finger tips, the other with the hollow of the palm. At that time, I thought of using a second turnbuckle armed with hooks to accomplish this, but I chose manual rather than mechanical control because of the danger of using too great force with the latter method. However, the experience of W. H. Bishop, of New York, whose material has been much greater than my own, has shown that it was awkward and rather unsatisfactory for an assistant to control the clamps. During a difficult reduction of a fractured tibia he accordingly slipped the loop handle of one of the Lane bone retractors over the free ends of both

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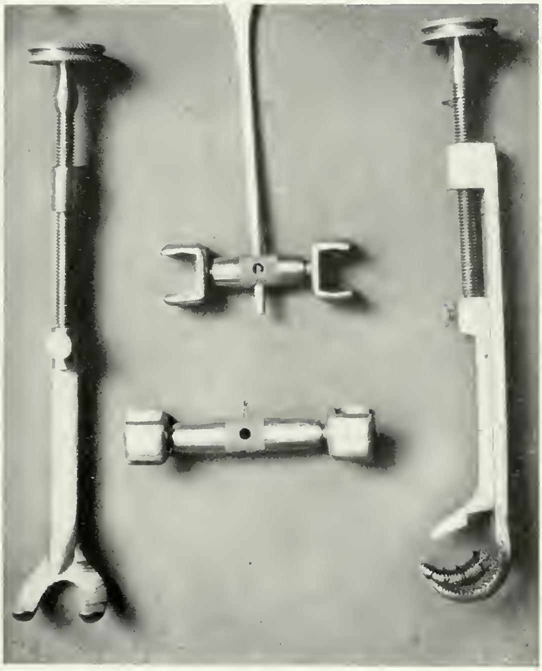
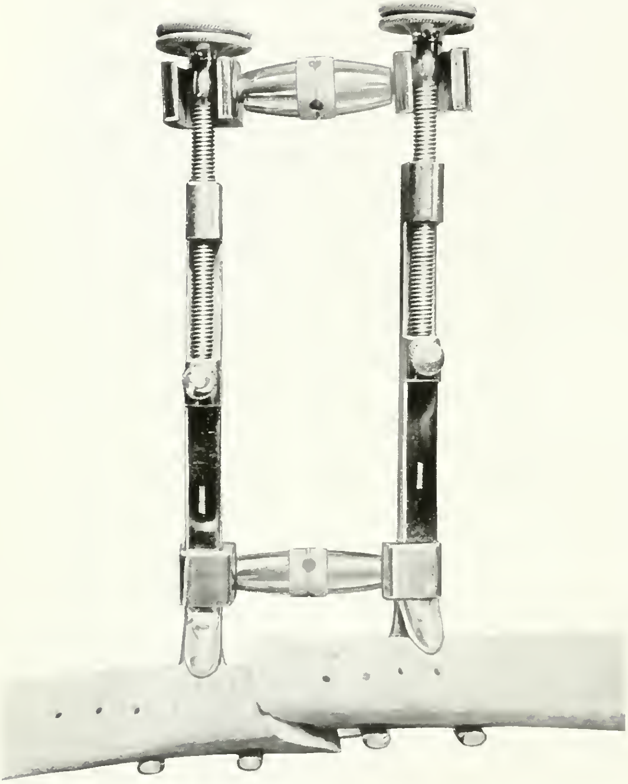
[1] "Reduction of the Fragments in Fractures of the Long Bones," Annals of Surgery, November, 1912, p. 769.

Fig. 5.



Anterior and lateral view of modified Lowman clamps. Smaller turnbuckle with key in place. Range of smaller turnbuckle is from 1⅞ to 2½ inches; range of larger turnbuckle is from 2⅜ to 3½ inches.

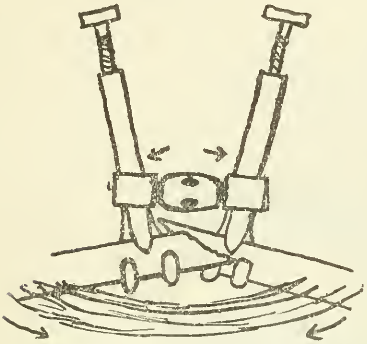
FIG. 6.



Photograph of clamps and turnbuckles applied to an adult femur (as in Fig. 3*a*).

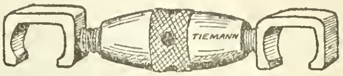
Lowman clamps and blocked up the free space left at one end until the clamps were parallel. As the turnbuckle forced the clamps apart, one block after the other was removed. Reduction was easy, and control was much more certain than by the assistant's hand. This crude make-shift was so satisfactory, that a turnbuckle was made, armed with hooks (Fig. 2) to keep the clamps parallel. As the turnbuckle close to the bone forces the clamps apart, the upper turnbuckle is released

FIG. 1.



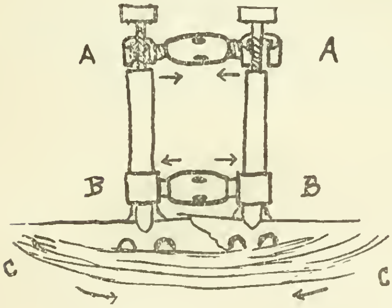
Showing tendency for distal ends of Lowman clamps to diverge because of resistance by soft parts.

FIG. 2.



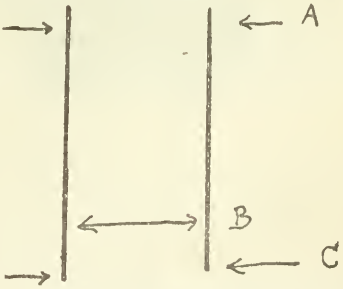
Turnbuckle armed with hooks.

FIG. 3*a*.



Divergence controlled by hooked turnbuckle at *AA*. Arrows indicate lines of force. Usually it is more convenient to apply turnbuckle at *BB*, maximally contracted, and to apply hooked turnbuckle at *A A*, expanded sufficiently to engage diverging shafts. Then this same turnbuckle at *A A* is contracted until clamps are parallel or nearly so, after this expansion of turnbuckle at *B B* can begin.

FIG. 3*b*.

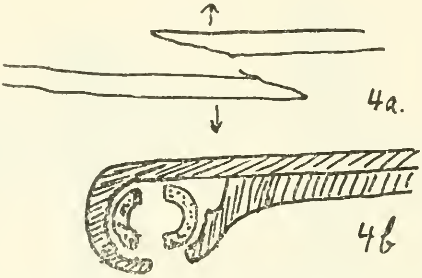


The Lowman clamps constitute levers; the turnbuckle at *B* is the fulcrum, the resisting soft parts at *C* and the turnbuckle at *A* balance each other.

just enough to maintain a proper parallel position of the Lowman clamps (Fig. 3*a*).

The six appended figures with their legends explain the mechanical conditions encountered and their method of control.

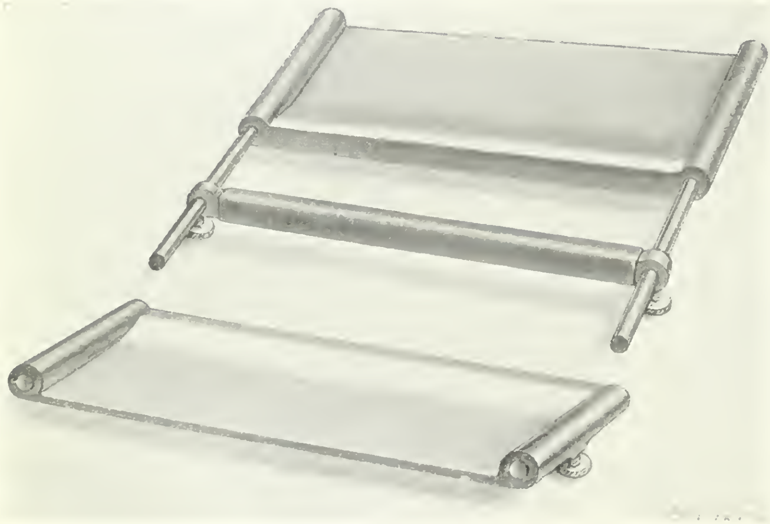
Fig. 4.



4*a*, during distraction frequently there is a tendency to lateral displacement. 4*b*, a third Lowman clamp, which embraces both fragments but is not tight enough to prevent distraction, readily controls this.

I still recognize the ease with which too great force can be applied by this method. Distention should be gradual, not sudden; after a certain amount of resistance is met with, it is well to pause a minute or two and then proceed again.

Fig. 1.



Gastro-enterostomy clamp.

A DEVELOPMENT OF THE AUTHOR'S GASTRO-ENTEROSTOMY CLAMP.

BY WILLARD BARTLETT, A.M., M.D.,

OF ST. LOUIS, MO.

In the Annals of Surgery for November, 1912, appeared Dr. Buchanan's article entitled "A Modification of Bartlett's Gastro-enterostomy Clamp." His most excellent suggestion referred to an instrument which I presented in the Annals of August, 1911.

The contrivance referred to produces uniform pressure at every point, the amount being directly determined by the fingers applying the instrument.

The accompanying illustration shows how the original idea has been developed and the contrivance improved. The two outside blades are now made so wide that the viscera and packs are held out of the operator's way, while at the same time the likelihood of soiling is greatly lessened. This later instrument is much easier to apply than was its predecessor. Now one has merely to compress the stomach between the fixed outside blade and the middle blade, which can be locked in position by the thumb screws underneath. In like manner the jejunum is fixed separately between the middle blade and the floating broad blade. All is now ready for the suture.

To remove the instrument, merely unfasten the four thumb screws underneath and withdraw the fixed broad blade. This allows the other two blades to fall apart and be taken out separately.

THE CHEVALIER JACKSON METHOD OF FINGER ELEVATION OF THE HYOID BONE IN GENERAL ANÆSTHESIA.

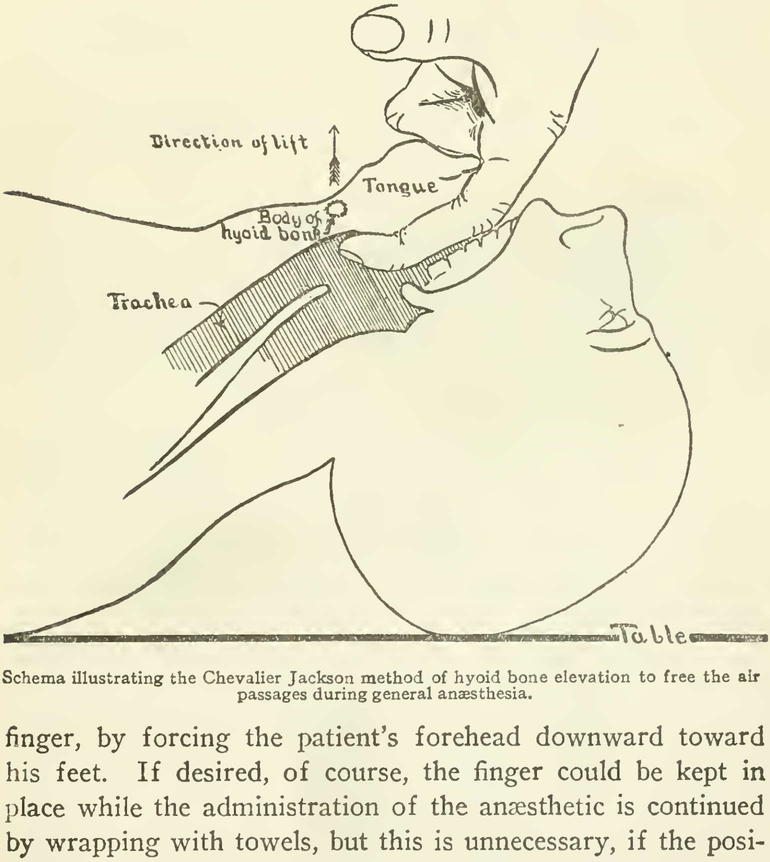
BY ELLEN J. PATTERSON, M.D.,

OF PITTSBURG, PA.

Assistant Professor of Laryngology, University of Pittsburg; Laryngologist, Presbyterian Hospital; Rhinologist, Eye and Ear Hospital Dispensary.

When the patient begins to lose consciousness in general anæsthesia, the tongue is prone to drop backward and obstruct the breathing. A very small amount of secretion then gives the impression that the patient is " full of ether mucus." Various tongue forceps, of more or less cruel design, and even a loop of suture material through the tongue, are used to draw the tongue forward. Bimanual upward traction at the mandibular angle is a well known and fairly satisfactory method of elevating the base of the tongue. By far the best method, however, and one which seems generally unknown, is to elevate the hyoid bone with the index finger introduced through the mouth and passed deeply posterior to the tongue, the motion being made as if to raise the entire head and neck with the *tip* of the finger, precisely as the hyoid bone and epiglottis are lifted with the Chevalier Jackson laryngeal speculum in direct laryngoscopy. In fact it was in Dr. Chevalier Jackson's clinic where it has been in use for years, that I was taught this finger method of elevating the hyoid bone to free the air passages. The method frees the breathing in a way that no amount of traction on the end of the tongue can accomplish. A patient who has been taking the ether badly, with cyanotic color, intense venous engorgement, in short the kind of patient who is generally known among anæsthetists as " a bad actor," will, immediately, upon using the hyoid bone elevation, take one great deep inspiration and thereafter will breathe so quietly that, unless the thoracic respiratory movements are noted, one is apt to think that breathing has ceased altogether. The color will clear up and the breathing will thereafter be free if the patient's head be maintained in the forced extension, direct laryngoscopy position (Fig. 1), with the head flat on the table. In this position, the neck is thrown upward and the hyoid bone is maintained in an elevated position once it has been elevated with the finger, by forcing the patient's forehead downward toward his feet. If desired, of course, the finger could be kept in place while the administration of the anæsthetic is continued by wrapping with towels, but this is unnecessary, if the position is correct. If the patient is only very slightly anæsthetized, retching may be caused by the presence of the finger, but the ether can be pushed as soon as a free air passage is restored. Some sort of bite block or gag must be used to prevent the finger being bitten, but wide gagging defeats the hyoid elevation.

FIG. 1.



Schema illustrating the Chevalier Jackson method of hyoid bone elevation to free the air passages during general anæsthesia.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated meeting, held at the New York Academy of Medicine,
April 23, 1913.

The President, Dr. Charles L. Gibson, in the Chair.

CARDIOLYSIS.

Dr. Charles N. Dowd presented a boy, nine years old, on whom he had done the operation of cardiolysis as an endeavor to mitigate his sufferings from an adherent pericardium. The boy had suffered from cardiac disability for five years, following rheumatism, of which he gave a history of repeated attacks, at one time being confined to bed for three months.

At the time of his admission to St. Mary's Hospital for Children, on October 25, 1912, his dyspnœa was excessive. He was unable to lie down nor could he take any exercise. He complained of precordial pain, and coughed after exertion or on reclining. Both physical examination and radiographic findings indicated an enormous cardiac enlargement. The right border of the heart was to the right of the sternum, and its left border was at the anterior axillary line. The apex beat was in the fifth intercostal space, three and a half inches to the left of the median line. There was a loud, rough systolic murmur at the apex, which was transmitted to the left. The pulmonic second sound was accentuated. The extremities were œdematous.

After careful hospital treatment for two months the boy showed slight improvement, but upon returning home his symptoms quickly recurred, and he was readmitted to the hospital.

Operation, January 31, 1913: About two and a half inches were taken from the anterior ends of the left third, fourth, fifth and sixth ribs and their cartilages, leaving a little of the posterior periosteum, as recommended by Fritz Koenig, but clearing it very thoroughly, as suggested by McEwen. After this hard portion of the chest wall was removed, the remaining portion moved very freely with the cardiac pulsations.

The boy's convalescence was interrupted by an attack of bronchopneumonia, but at the present time, nearly three months after the operation, he is slightly better than he was before he had been operated on. The mechanical procedure in this case, Dr. Dowd said, was easy. The result, up to this time, was neither very encouraging nor very discouraging, and it indicated that further trials might well be made in properly selected cases.

FOUR GASTRIC AND DUODENAL CASES BEARING ON THE QUESTION OF AN OPEN PYLORUS AFTER GASTRO-ENTEROSTOMY.

Dr. Eugene H. Pool presented the following patients: Case I. *Persistent Vicious Circle.*—The first case of the series was shown to illustrate the possible ill-effects resulting from the coexistence of a wide-open pylorus and a gastrojejunostomy. Closure of the pylorus in this case effected a cure, showing that the symptoms—persistent vomiting and emaciation—were due in this case to the open pylorus.

The patient was a Sister of Charity, thirty-two years old, who was operated on in another city six months before she came to the French Hospital. The operation had been done for the relief of gastric symptoms of about six months' duration, consisting of severe attacks of pain usually coming on from fifteen minutes to half an hour after meals, and vomiting; the vomitus often containing blood. The particulars of this operation could not be learned, but the patient stated she was told that an ulcer was found. Directly after the operation she said she began to vomit, at first mucus and gastric juice; later bile-stained fluid. Gradually this symptom became more aggravated until she vomited almost continuously, often several basinsful daily. She seldom could retain food, sometimes being able to keep down a few ounces of peptonized milk, but nothing solid. This continued for six months, and she became much weakened and emaciated.

Operation revealed a large gastro-enterostomy opening and a normal pyloric opening. There were no apparent kinks or adhesions, nor any lesion in the stomach or duodenum. It was decided that closure of the pylorus was likely to relieve the symptoms, and that at the same time it was the safest procedure. Because of the uncertainty of its result, however, and the poor condition of the patient, the simplest method was employed. A heavy catgut suture was passed around the pylorus and tied so as to close its lumen, but not crush the tissues. A number of linen Lembert sutures were inserted, approximately the tissues across this groove; these were placed on the anterior surface and as far posteriorly as possible. Vomiting occurred for four days after this operation and then ceased. Since then the patient had remained perfectly well; she had gained considerable weight and strength, and could eat any kind of food.

Case II. *Gastro-enterostomy with Occlusion of Pylorus by Ligature-suture Method for Duodenal Ulcer.*—Dr. Pool said that even before the above described experience he had felt that an effort should be made to avoid producing a gastro-enterostomy if the pylorus was left open or was likely to re-open. In his second case this error was avoided by closing the pylorus in the same manner as above. This patient had rather acute and severe symptoms indicating an ulcer, and upon operation, a small, indurated ulcer was found on the anterior surface of the first portion of the duodenum. The pyloric opening was quite large. The pylorus was closed as in the first case and a posterior gastrojejunostomy performed. This operation was done ten weeks ago and the result thus far had been perfectly satisfactory.

While this method was not a new procedure it was used in these cases in a somewhat modified form after a suggestion made to him by Dr. Martin. The permanency of this method of closing the pylorus was still doubtful. Of course, as experience had shown, such an accessory to a gastro-enterostomy was often unnecessary as is shown in the next case.

Case III. *Benign Stenosis of Pylorus following Subphrenic Abscess Due to Perforated Duodenal Ulcer.*—In this case there was a firm, cicatricial, contracted pylorus, which suggested little likelihood of dilatation. The patient had been operated on in February, 1912, by Dr. Charles H. Peck, for a large subphrenic abscess, the incision being made along the free border of the right costal arch. The patient stated that after this wound had completely healed, in April, 1912, he began to have pain in the epigastric region, with vomiting once or twice daily. The vomitus consisted of food and mucus; he had never noticed any blood.

This condition continued for perhaps six months, when he began to vomit after each meal. He could practically retain no food, and became much emaciated and weakened.

Operation, February, 1913, revealed a hard, cicatricial area involving the first portion of the duodenum, which was imbedded in dense adhesions. A gastro-enterostomy was done, with entire relief of symptoms.

CASE IV. *Excision of Duodenal Ulcer with Pyloroplasty.*—In the last case shown by Dr. Pool, a young man who was operated on in July, 1912, it was decided to do a pyloroplasty with excision of the duodenal ulcer in preference to a gastro-enterostomy, the normal anatomical conditions thus being more nearly preserved, two outlets from the stomach being avoided and the stomach being adequately drained. This procedure was planned to meet the surgical indications in a certain type of duodenal ulcer. Its aim was the excision of the ulcer, with enlargement of the lumen of the pylorus. It was thought that for the reasons already enumerated it might be employed advantageously in dealing with certain small ulcers on the anterior wall of the duodenum near the angle of approximation in a Finney operation. Its trial in this case had proven only partially satisfactory, and Dr. Pool said he would hesitate to resort to the procedure again on account of the likelihood of the etiological factor, which had given rise to the first ulcer, continuing to act and resulting in the development of further ulcers. The patient did well for a time, but for several months past he had suffered from considerable pain in the epigastrium several hours after eating. This pain was relieved by taking a cup of tea or hot water. His general condition, however, had improved greatly; he was now able to eat anything and was not subject to belching and vomiting as he was prior to the operation. His symptoms, however, suggested the development of another ulcer.

DR. ARPAD G. GERSTER said he had under his observation at present a patient upon whom a gastro-enterostomy was done for an ulcer in the vicinity of the duodenum. The posterior operation was done, and the antrum pylori was constricted. That patient improved very much after the operation, but returned six months later complaining of his former symptoms, and upon examination, a palpable tumor was made out. When the abdomen was reopened it was found that in spite of the presence of the ligature, the patency of the pylorus had been re-established, and a large mass involving, apparently, the stomach, duodenum and transverse colon was made out. This was feared to be malignant, but as a peptic ulcer could not be excluded, the speaker said he advised Dr. A. A. Berg, after some consideration, to do a jejunostomy, after which the patient's condition immediately began to improve, doing so well, in fact, that the suspicion of carcinoma was practically discarded while that of a peptic ulcer was rendered more probable.

At the last meeting of the Society, Dr. Gerster said, Dr. Lilienthal presented a case where a Finney operation was done, in 1908, for a benign stenosis of the pylorus. The symptoms recurred, and four years after the primary operation, when the abdomen was re-opened, the stoma made by pyloroplasty had shrunken to such an extent, that it was scarcely possible to insert the end of a probe. To-night, Dr. Pool showed a somewhat similar case, which simply went to show that the Finney operation did not possess a very decided advantage over the ordinary pyloroplasty, and he wished to emphasize what he has said at the last meeting, namely, that this operation did not do away with the vicious tendency to hyperacidity which gave rise to the ulcers.

At a recent meeting of the Deutsche Gesellschaft in Berlin, the question of whether or not to exclude or tie off the pyloric end of the stomach gave rise to a very lengthy and interesting discussion. Some were strongly in favor of this procedure, notably von Eiselsberg, who advocated complete division of the stomach, while others, more especially Koch, said that they never practised exclusion of the stomach, and their results seemed to be better than by any other method. No satisfactory conclusion could be arrived at, however, and the matter was left undecided.

Dr. Pool said that in his fourth case, to which Dr. Gerster had referred, he had no reason to believe that the Finney pyloroplasty had contracted, but what he wished to emphasize was that the recurrence of the characteristic pain was suggestive of the development of another ulcer in the duodenum.

FRACTURE-DISLOCATION OF THE SHOULDER.

Dr. William Darrach presented a woman, forty-six years old, who on January 24, 1911, fell with her arm behind her back, striking on her shoulder. A month later she came to the Out-

Patient Department with signs of a dislocation of the shoulder, which were verified by the X-ray. There was at this time complete deltoid paralysis, with anæsthesia over the region of the circumflex.

Reduction under anæsthesia having failed, an open operation was done 35 days after the injury, when it was found that the muscular attachments had been torn from both tuberosities, and the head of the humerus had been dislocated to the subcoracoid position. A shell of bone, with the subscapularis attached, lay against the glenoid, preventing reduction. When this was pulled aside, the head seemed to enter the glenoid cavity, and after suturing the lesser tuberosity in place, the wound was closed. Primary union resulted, but the X-ray showed that the head was still out of the glenoid. The wound was re-opened three weeks later, when it was found that the muscles had also been torn from the greater tuberosity, taking some of the bone with them, and that the head of the bone had originally been forced through this upper rent in the capsule. In the previous reduction the head had been forced through the opening made by the tearing off of the lesser tuberosity, so that the long head of the biceps and a strip of capsule were wrapped around the neck. These were unwound, and the head made to enter the proper opening. The subscapularis was again sutured to the lesser tuberosity, and an attempt made to bring the spinati to their normal attachment with chromic gut. The wound was closed, and the arm put up in abduction.

The operation was very difficult and prolonged, and the gloved finger was introduced several times into the wound. The temperature reached 101.4° on the second and third days; then fell to normal and remained so. The wound was dressed on the eighth day, when half a drachm of thick, yellow pus came from the region of the pectoral muscles. This drained freely for a time, the skin finally and permanently closing 36 days after operation. No attempt was made to investigate the circumflex nerve at either operation.

At the present time, three years after the operations, the head of the bone was in place and there was full range of passive motion. The deltoid, however, was completely paralyzed, with marked interference with the function of the joint. The spinati had apparently maintained their attachment, as there was about

10 degrees of active abduction, and the supraspinatus could be felt contracting during this act. With passive abduction there was 90 degrees of active rotation. The patient was unable to fix her hair unless she leaned over. She was able to fasten her waistband in the back, and do washing and ironing, but was unable to scrub floors. There had been no evidence of osteomyelitis or arthritis.

FRACTURE OF THE RADIUS: LOWER SHAFT.

Dr. Darrach presented a man, thirty-eight years old, who five days before his admission to the hospital fell fifteen feet, fracturing his left lower radius. After several unsuccessful attempts at closed reduction, an operation was done on February 22, 1913. The upper end of the lower fragment was found anterior and to the ulnar side, a fragment of muscle being interposed between the broken ends. There was 90 degrees of rotary deformity. A 4-screw vanadium steel plate was applied, and the wound closed tight. The operation was of longer duration than usual, owing to a number of technical difficulties, but the most careful Lane technic was observed throughout. The patient's temperature rose to 102.2° on the second and third days; then it became normal and remained so until the tenth day, when it again rose to 102°. The wound was not dressed until the following day, when the stitches were removed, and owing to slight redness and puffiness the skin edges were separated and at least three ounces of creamy pus were evacuated from the deeper space. There was no odor to the pus, and remarkably little swelling of the forearm. A culture taken from the pus was negative. The wound was opened widely and packed with formalin gauze. It drained freely for a few days and healed at the end of twenty-four days. Twenty-one days later the scar was excised and the plate removed, all four screws still holding firmly without any signs of exudate. The bone under the plate was smooth and shining, with no evidence of repair on that side of the bone. The rest of the circumference of the bone was not disturbed. The wound was closed without attempting to remove the blood, hoping that the clot would hasten repair. The stitches were removed on the eleventh day, with firm union and without redness. Fourteen days after the second operation a blister appeared, which was opened and about half a drachm of clear serum expressed. There was still motion to be felt at the site of the fracture, eight and a half weeks after the original injury.

OPEN OPERATION FOR FRACTURE OF THE CLAVICLE: MIDDLE THIRD.

DR. DARRACH showed a man, forty years old, who on January 30, 1913, fell, striking his left clavicle against a corner of stone. He was treated at several hospitals and dispensaries, first with a Velpeau and then with a Sayre. While the latter bandage was in place he complained of anæsthesia over the ulnar aspect of the hand, with loss of power in his fingers. He was admitted to the hospital twenty days after the receipt of his injury and an operation was advised, but it was postponed for a week, as he was running a little temperature, due, apparently, to pulmonary conditions.

On March 1, 1913, an open reduction was done, and a 4-screw vanadium steel plate applied, the Lane technic being carefully observed. The dressing was changed on the third day, as his temperature had ranged between 100° and 101.2°. There was a little puffiness at one point of the wound, and on separating the skin edges, perhaps five drops of what looked like melted fat were evacuated. The wound was swabbed with Churchill's tincture of iodine; it healed without further discharge and had remained closed since. A culture of the discharge showed staphylococcus.

At the time of the operation, the inner end of the outer fragment was found to be pressing on the lower portion of the plexus. One of the screws inserted in the bone plate became loosened, allowing a slight displacement, but the general position of the bone remained good. The bandages were finally removed at the end of 26 days. The local anæsthesia had disappeared, and the muscles were beginning to contract feebly. There was still a good deal of limitation of motion in the entire extremity, which was decreasing under massage and passive motion.

Dr. Darrach reported one other case of a badly lacerated, compound, comminuted fracture of the tibia and fibula where the plate had to be removed because of infection. In that case, the sinus persisted for about six months. It remained healed for six months, when he died six weeks after an abdominoperineal proctectomy for carcinoma.

Dr. Darrach said that of his series of 144 cases of open operation for fractures and dislocations, infection had followed in five, which included the compound case reported to-night. Two of these infections had occurred before they had adopted the Lane technic, which they now try to carry out in all cases. In one case of infection occurring since then, it could be traced to a break in the technic. In two later cases no cause for the infection could be found. The number of cases of infection given above did not include three cases where chromic gut was discharged at a late period, nor two cases where phosphor bronze wires were removed, as they were threatening the skin.

Dr. Gerster said he was glad to see the cases shown by Dr. Darrach, as they served to illustrate the fact that the open method of treating fractures with a plate or pin or otherwise, which had recently become so popular among surgeons, was by no means a simple procedure and in many instances might result in injury or even loss of life. At the Mt. Sinai Hospital, where fracture cases were comparatively rarely admitted, about 25 cases had been treated by the open method, and Dr. Gerster then reported in detail one case of fracture of the radius in a young man, apparently in perfect health, where, in spite of every possible aseptic precaution, the open method of reduction was followed by rapid and fatal sepsis.

ENDARTERITIS OBLITERANS RELIEVED OF SYMPTOMS AND FUNCTION BECOMING RESTORED IN CONJUNCTION WITH THE USE OF THE SCHNEE FOUR-CELL ELECTRIC BATH.

Dr. William C. Lusk presented a case of endarteritis obliterans, the history of which was as follows:

Male, age thirty-five. Onset of present disease early in 1901. For the previous 9 years he had worked as a carriage trimmer and operated a heavy sewing machine with his feet. The first symptom was a cramp in his left calf, coming on during walking. The cramp increased in frequency until at the end of 6 months he could walk only about one block. At this time he began to have a burning pain over the dorsum, and in the toes, of the left foot, especially in the big toe, which stopped his walking. The big toe got blue. The big toe-nail was removed for " ingrowing toe-nail " without relief. He was treated in a hospital with wet carbolic

(2 per cent.) dressings for 9 weeks. The great toe became black and was amputated and the pain was considerably relieved. The wound did not heal. Two months later (July, 1902) the pain recurred. In the next year and a half the patient was treated at dispensaries, he suffering great pain and getting around on crutches. In February, 1904, he was admitted to Bellevue Hospital where he remained for 13 months. In the summer of 1904, all the remaining four toes of his left foot dried up and dropped off. On October 15, 1904, the foot was amputated (Pirogoff's amputation) by Dr. Bryant, resulting in complete relief of the pain. About a year later the patient returned to his former occupation again, plying the same heavy sewing machine, but now with his right foot only, he wearing a left artificial leg.

He was then well until November, 1910, when his right calf began to cramp when he walked. He now gave up the use of the foot-power. The cramp grew progressively worse and about November, 1911, he began to have a burning pain in the great and little toes, much worse in the latter, of the right foot, which he characterizes as "awful" and "something terrible." A little later there developed in his little toe and outer side of the sole of his foot a "freezing" pain which was much less endurable than the burning pain. In December, 1911, the great and little toe-nails fell off. Early in January, 1912, no arterial pulse could be felt in the right leg and the circulation was poor. The patient then entered St. Vincent's Hospital where he was treated with heat and Bier's hyperæmia, an elastic bandage being applied around the thigh daily for 20 minutes, sufficiently tight to cause slight venous congestion. Bier's negative pressure previously applied to a case somewhat akin to this one, by Dr. George D. Stewart, had been followed by relief of the symptoms. After 5 weeks of treatment with the elastic bandage, there was in this present case little or no pain remaining, the foot was no longer cyanosed when it hung down, and the patient was sleeping well. The patient was then free from pain until July, 1912, the great toe-nail in the meantime having grown again.

With the recurrence of the symptoms he again entered St. Vincent's Hospital, the end of last August. The use of the elastic constriction again, combined with mixed treatment, now gave no relief whatever. The patient suffered severely again from what he termed the "freezing pain" which affected the little toe and outer portion of the sole of the foot, which sites were always those of the greatest pain. There was also the "burning pain" in the great toe and in a small area on the dorsum of the foot at the bases of the first four toes, and in another area in front of the outer portion of the ankle-joint. The foot became cyanotic, at least in the painful areas, when it hung down. The small ulcer resulting from the loss of the little toe-nail in December, 1911, still existed. It did not lead to bone. Finally on November 10, 1912, treatment with the Schnee[1] four-cell electrical bath was instituted. This bath (Fig. 1) consists of four porcelain tubs filled with water, in which the extremities are immersed, the water being electrified through the medium of carbon or metal electrodes, those of the foot tubs being connected to the positive pole while those of the arm tubs are connected with the negative pole. This treatment was known to cause an erythema of the skin of the submerged portions of the extremities during the passage of the current, and its continued use was reputed to produce a gradual improvement in the circulation of the extremities, so that it was deemed worthy of a trial. The current was taken from a fixture through a rheostat.

The patient had had to date (April 23) 156 of the electrical baths, which treatment had been attended with a variety of effects. The current at the beginning was used at 20 ma. but in two or three days was established at 30 ma. for 10 minutes. During the first month the improvement was marked and the patient became practically free from pain. On December 9, however, he had a sudden return of the "freezing pain" in and around the right little toe, which attack lasted about 12 hours. At the same time a "drawing pain" developed at the inner side of his leg, which he had had at a previous time. After this the pain would come on in attacks alternating with periods of intermission. At this time the pain would always be arrested or eased for a number of hours consequent upon taking the bath. Thus on December 14, 1912, after a bath at 1.30 P.M., the pain was eased until midnight. On December 15, 1912, the bath was omitted and his pain the following night he described as "awful." Immediately after his bath on December 16 the pain all left and that night he slept 8 hours. Later, however, at a time when the skin seemed to have

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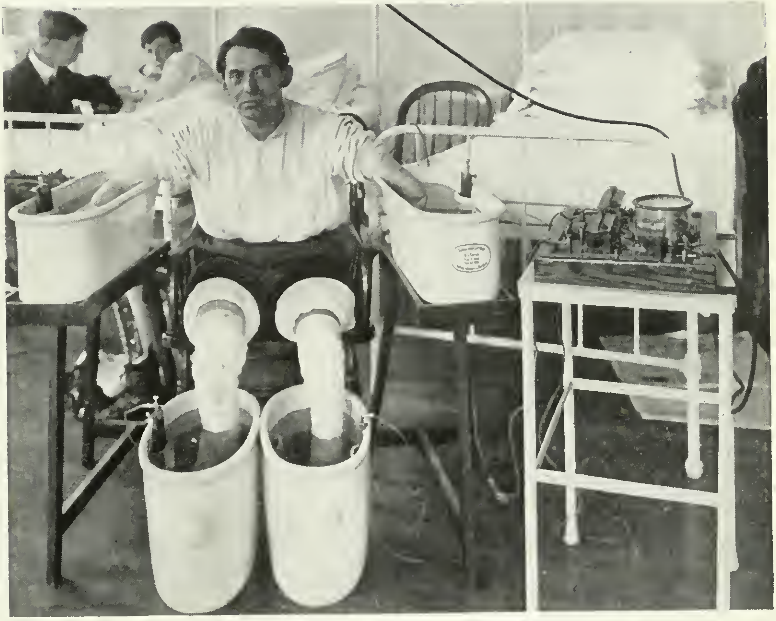
[1] A. Schnee: Das elektrische vier-zellen Bad. Medicinische Blätter, xxx, 1907, p. 519.

FIG. 1.



The Schnee four-cell electric bath used in the treatment of a case of endarteritis obliterans. The current is taken from a fixture through a rheostat. The positive pole is connected with the electrodes in the foot tubs, and the negative pole with the electrodes in the hand tubs. A current of 30 ma, for 10 minutes, used at the beginning with favorable result, later caused pain, so that the strength had to be reduced to 10 ma. for 10 minutes to obtain the proper therapeutic effect.

grown more sensitive to the electrical stimulation, with the same strength of current a marked augmentation of the pain would come on during the bath, so that the current had to be reduced considerably to re-establish the therapeutic effect of the treatment. On December 11, 1912, the patient made the observation that the nails and hair of his toes had begun to grow again after a period of indolent growth, in the previous two years he having been obliged to cut his toe-nails only 2 or 3 times, whereas in the past month he had cut them twice. On January 9, 1913, it was recorded that in the day-time when the patient sat with his right leg flexed and foot in a chair, the pain did not bother him, but as soon as he lay down the pain would start up. Warmth was always grateful and he usually sat close to the radiator. The foot and leg were kept wrapped in cotton and a fur-lined shoe was worn. On this date it was discovered that the baths were being given with the negative wire attached to the foot tubs and the positive wire to the hand tubs. The patient was sure that this disposition of the wires had not varied from the beginning of his treatment, yet it was known that the direction of the current was originally started right. The poles were forthwith connected with their proper electrodes. On February 1 it was recorded that since the readjustment of the poles, on January 9, the improvement had been progressive. The patient was still comfortable in the day-time, and at night the pain would come and go at intervals so that the patient could usually get 3 or 4 hours of sleep. Jumping of the leg at night had been arrested by a plaster splint. Raising the head of the bed seemed to diminish the pain at night.

During the latter part of January the patient began to notice that there was an increased sensitiveness in his legs to the electrical stimulation in the bath, which increased to such an extent that by the middle of February the bath after the first 4 or 5 minutes actually excited pain in the right foot, so that on February 17 the strength of the current was reduced to 20 ma. On February 24 it was recorded that the pain not only continued to be excited by the baths, but it was now excited also by walking " even by two steps." The pain, which was intermittent, lasting about 1½ hours and then arresting for about 1½ to 2 hours, was now worse in the day than at night. It affected chiefly the little toe and the outer side of the sole of the foot. On February 25 the bath was omitted and the pain was worse.

On February 26 a test was made with the bath to see how long a current of 15 ma. could be used before it would excite pain. The pain came on with this strength of current in 13 minutes, at the expiration of which time the bath was discontinued. The pain after this bath lasted only ½ hour and the patient was then comfortable for the rest of the day and slept all of the following night. The baths were then given, using a current of 15 ma. for 15 minutes, with which treatment the attacks of pain were less severe, but they still excited some discomfort so that on March 1 the current was further reduced to 10 ma. and the time to 10 minutes. From this time on improvement progressed unabatedly and rapidly. The attacks of pain became shorter and less severe and the intervals longer. On March 6 the pain after walking lasted only 15 to 20 minutes and was not very severe. Then during a cold snap the pain increased. The patient had his last severe attack of pain on March 15, which lasted 3 hours, after which the attacks of pain became hardly noticeable and then, excepting for a very slight attack of pain on April 10, disappeared entirely the latter part of March. About April 1 the patient gave up the use of his cane. The administration of mixed treatment in conjunction with the baths was studiously limited, it having been allowed only for one day, the end of February, and again for not more than a week, early in March.

At the present date, the foot is no longer cold; the ulcer on the little toe has healed all but for a small opening which just admits the extremity of a probe; (the variations in the color of the toes had not at this time been noted; cyanosis affected most noticeably the dorsum of the little toe); the muscles of the leg have been developing; the patient walks short distances quite easily though a little stiffly. This stiffness in gait, together with a little soreness around the ankle-joint during locomotion, seem to be only accompaniments of the bringing into use again of long disused parts. The ankle-joint itself has complete normal mobility. Since February 11, the patient has gained 7 lb. in weight.

Note.—May 14, 1913. The baths, using 10 ma. for 10 minutes have been continued. The soreness on locomotion is nearly all gone and the patient walks more easily. For two weeks preceding May 9 the patient had been sleeping 9 to 10 hours every night. Since May 5 the patient has been troubled with a burning sensation, for the most part momentary in duration and coming on chiefly after going to bed, on the dorsum or at the base of the little toe, on two nights it waking him from his sleep for a few minutes at a time, and on another night (May 12) it making him quite restless. Twice in this period of time, with the occurrence of a little swelling of the little toe, a drop of retained pus was let out from the diminutive sinus in this toe.

The color of the toes has recently been made a matter of observation. The little toe is the one most liable to cyanosis. This toe, with the patient standing, has been seen to spontaneously change in color from bluish to a brilliant rose. The toes, on three successive days, have become a little dusky following moderate exertion in the morning, before the bath, but after the bath there seemed to be little tendency to cyanosis with ordinary exertion. On the morning of May 13 before the bath, after walking 50 feet, all the toes were slightly dusky, but after the bath, during the afternoon, more than one hour of which was spent in slow walking around and standing, the toes were found at each of several observations, to be always a good red color, excepting for a very faint bluish tinge around the scar on the little toe. Standing heavily on the right foot, however, toward evening, produced duskiness of all the toes within three minutes.

In a second case of endarteritis obliterans the treatment of which has just been begun, after the first electric bath (20 ma. for 10 minutes) the patient was entirely free from pain for 5½ consecutive hours, whereas previously the intervals of relief had been of no longer duration than half an hour, and after his second bath (10 ma. for 10 minutes) the relief from pain lasted 9 hours.

RECTUS TRANSPLANTATION BY A SPECIAL TECHNIC.

DR. WILLIAM C. LUSK said he presented this case for the purpose of bringing up for discussion the question as to what was the best technic for performing Bloodgood's operation of transplanting the rectus muscle.

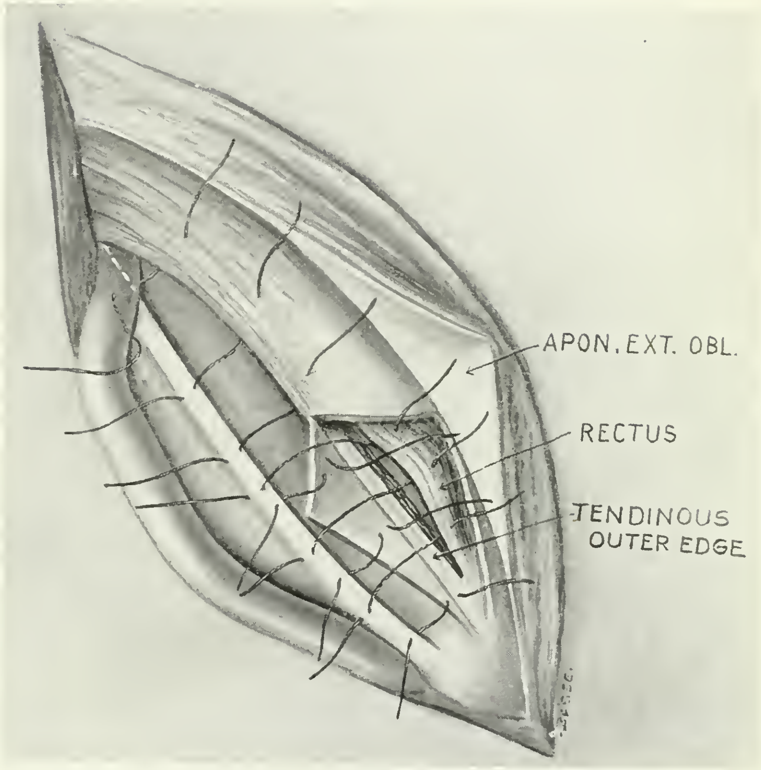
He said the patient was one in the service of Dr. Bissell at Bellevue Hospital; that he had a recurrent inguinal hernia which was direct, and that repair was effected in accordance with the technic shown in the illustration and described herewith, excepting that the outermost stitch in the rectus sheath also included the rectus muscle instead of there being separate stitches at this situation; that the patient was operated on November 30, 1912, and returned to his work, which was that of a motorman, on a trolley car, 5 weeks later, in which occupation he had been actively employed since, using the hand break of the trolley most of the time. The abdominal wound was at the present time solid.

Dr. Lusk said he had for a good many years practised entering the rectus sheath in front through the portion internal to the conjoined tendon after first raising therefrom the overlying aponeurosis of the external oblique. To enter the rectus sheath from behind working beneath the muscles, had always seemed to him to be an awkward procedure, and, in the presence of an intact transversalis fascia in the floor of the inguinal canal, inadvisable.

He said that formerly he had used a low vertical opening in the front of the rectus sheath beneath the aponeurosis of the external oblique, extending down to the pubic crest, with which technic the rectus was usually drawn out laterally under some restraint. Recently he had added to the vertical cut at its upper extremity, a transverse cut, dividing the sheath out to its outer edge, which step in the technic he wished to call especial attention to. By cutting the flap in this way in the shape of a right-angled triangle, the sheath was laid open out to its outer edge so that the rectus muscle could be liberated from its intramural attachments under guidance of the eye, and its lateral displacement was no longer restricted by the sheath. Another advantage of this anterior triangular flap method he said was, that the sewing of the everted flap to Poupart's ligament interposed another layer to replace the deficient conjoined tendon. This line of union should be effected by a separate row of stitches. It was easier to make the transverse cut first and follow it with the vertical one. The sutures in the flap made from the sheath should catch Poupart's ligation near its deep border which was more or less rigidly held, while those in the rectus muscle should catch Poupart's ligament through its more superficial fibres, which had some mobility and would therefore be drawn upward to meet the rectus partway as the sutures were tied. In the repair the aponeurosis of the external oblique directly overlay all that portion of the transplanted rectus which was situated above the level of the transplanted cord, thus in large part supporting the area in the front of the rectus sheath from which the triangular flap had been cut.

As regarded the surgical anatomy, Dr. Lusk said that the outer

FIG. 2.



This technic represents only what has already been done by others. Wölfler (*Beiträge z. Chir. Festschrift f. Th. Billroth*, 1892), who was the first to transplant the rectus muscle, did it through an anterior opening in the sheath. Halsted (*Johns Hopkins Hospital Bulletin, August*, 1913), in 1899, originated the turning over of a flap cut from the aponeurosis covering the front of the rectus muscle with suture of the same to Poupart's ligament, to close the lower part of the inguinal canal. Berger (*Revue de Chirurgie, January*, 1902) also originated a similar flap for the repair of inguino-interstitial herniæ. Bloodgood, with whom transplantation of the rectus muscle was also original, originally transplanted the rectus muscle through a posterior incision in its sheath (*Johns Hopkins Hospital Reports*, vii, 1898–99) but later adopted the triangular flap from the front of the rectus sheath devised by Halsted, and then transplanted the rectus muscle through this anterior opening in the sheath, sewing the flap from the sheath and the rectus muscle each to Poupart's ligament by a separate row of sutures (*Internat. Clinics*, 18th Series, vol. i, 1908, p. 296). In this dissection the outer edge of the rectus muscle was tendinous and closely attached to the posterior layer of the sheath, and was therefore split through instead of dissected free, in order to raise the belly of the muscle.

edge of the rectus muscle in the operative field was usually adherent to the posterior fascial layer of the rectus sheath, frequently by a tendinous attachment but sometimes only by fascia; and that when this attachment was a tendinous one, then to raise the muscle out of its sheath the outer border must be split through instead of dissected free, since to dissect it free would necessitate cutting through the posterior fascial layer of the sheath, thus impairing the support given by the latter fascia. He said that the transversalis fascia forming the posterior layer of the rectus sheath was generally a structure of much firmness, which, when firm, would give support to a poorly developed rectus muscle transplanted through the anterior route. In 5 out of 6 dissections on 6 cadavers, the posterior layer of the rectus sheath was one of considerable strength, but in one cadaver there was found in it at a situation a little above the pubic crest, a small area of weakness which offered but little resistance to the finger pressed through it from behind.

RECTUS TRANSPLANTATION FOR DEFICIENCY OF THE INTERNAL OBLIQUE MUSCLE IN CERTAIN CASES OF INGUINAL HERNIA.

Dr. William A. Downes said that at a meeting of the Society held at the New York Hospital over two years ago, he described a method of rectus transplantation which he had now employed in about 165 cases during the past four years. Of this total number of cases he had been able to keep trace of about 60, and in only one of those had there been a recurrence. All of these cases were either of the direct or combined indirect and direct variety. Although the method he had described was more complicated and necessitated more handling and dissection of the tissues, he has never seen infection occur.

Dr. William B. Coley said he agreed with Dr. Schley in regard to the necessity of transplanting the rectus muscle in every case of direct hernia and in certain cases of indirect hernia. There were various methods of doing this since that first described by Bassini, and later by Wolfler and Bloodgood. Personally, Dr. Coley said, he favored that of Dr. William A. Downes, which had the particular advantage of placing two different layers of sutures under the cord, whereas with the other methods there was only a single layer. The speaker said he had followed this method in a large number of cases, without having seen a single recurrence thus far.

Dr. A. V. Moschcowitz said that in spite of the employment of so-called radical methods for the cure of hernia, recurrences were occasionally seen even in the hands of the best of operators. The speaker said he had been watching very carefully for the cause of such recurrences, and he had come to the conclusion that they were not due to failure to transplant the rectus. His investigations had shown that by the time the recurrence took place, the question of whether the original operation was a Bassini or a Coley or a Halsted had lost its import—it was something entirely different. In most of the cases where a recurrence had taken place he had found that the conjoined tendon or united internal oblique and transversalis had become entirely separated from Poupart's ligament, and that the fault manifestly lay with the suture material.

Dr. Moschcowitz said that three or four years ago, before a meeting of the Surgical Section of the N. Y. Academy of Medicine, he made the statement that the choice of a suture material in these cases made little difference. Since then he had changed his views on that point, and he now believed that an absorbable suture material in these cases became absorbed before the muscles had time to properly unite with Poupart's ligament. Personally, he was now doing all operations for the cure of hernia with silk or Pagenstecher sutures, and his results were much more satisfactory than formerly.

Dr. Robert H. M. Dawbarn said that while he agreed with Dr. Moschcowitz that the cause of the recurrences in these cases was the separation of the conjoined tendon from Poupart's ligament, he did not believe that the explanation for the separation lay in the use of a non-absorbable suture material. Even in the description of Bassini's original technic—which the speaker said he had recently reviewed—nothing was mentioned of the extreme importance of loosening the conjoined muscle, both as to its superficial and deep surfaces so that there would be an entire absence of tension. In his own work, Dr. Dawbarn said, he made it a rule to strip the conjoined muscle until it practically rested down against Poupart's ligament without any tension. In surgery, as in matrimony, an unwilling union was apt to be followed by divorce.

More than twenty years ago, the speaker said, Dr. Willy Meyer wrote a paper in which he reported his experiments with the use of silk, cotton and linen sutures, and referred to the advantages of the latter as a suture material. Practically, since that time, Dr. Dawbarn said, he had discarded silk and had substituted linen. He understood that the Mayos were also using linen of late, in all abdominal work. Originally the strongest of the three suture materials named, linen is not, like silk, weakened by the necessary boiling for sterilization; and as Dr. Meyer proved that all three are equally well tolerated by the bodily tissues, there seemed left no excuse for employing silk.

A point worthy of remembrance, Dr. Dawbarn added, is that both linen and silk, when the smaller sizes are used, are capable of being absorbed and disappearing; but this only after a much larger period of time than any kind of material requires, ordinarily classed as "absorbable."

Dr. L. W. Hotchkiss said that Halsted did not transplant the rectus muscle, but he turned over the transversalis flap from its anterior sheath, and joined it to Poupart's ligament. He did not use the muscle because he did not believe it would hold.

Dr. Coley said that he could not let the opportunity pass without saying a few words in the defence of absorbable sutures in hernia operations. Many years ago, the late Dr. Wm. T. Bull, together with the speaker, published a series of cases of hernia in which various kinds of non-absorbable sutures had been used with serious after-results in the way of sinuses and prolonged suppuration. In one case with primary union, in which silkworm gut had been used, a sinus developed at the end of six months, another 2½ years later and a third 3 years and 8 months after operation. Not until all the sutures had been extricated did the sinus formation cease. (In this case the long-continued suppuration resulted in a recurrence of the hernia.) Similar results were seen following the use of silk and silver wire. The speaker said that he believed that the statistics of the Hospital for Ruptured and Crippled, covering a period of 23 years and including nearly 4000 operations in which chromicized kangaroo tendon had been used with less than 1 per cent. of relapses, were sufficient to prove that non-absorbable sutures were unnecessary in hernia operations. Dr. Coley stated that any suture that remained in the hernial canal unabsorbed longer than 3 to 4 weeks did harm rather than good. If there was any tension upon a suture after this period, such suture would cut through until there was no longer any tension, and then it would act as a foreign body. He stated that, within a single year, he had recently operated upon two cases in young adult women, for sinuses following an operation, developing a year after the introduction of silk sutures, at two of the leading German Clinics.

Dr. Moschcowitz said he did not wish to imply by his remarks that permanent sutures were necessary, but that it was important to choose a suture material that would last longer than did chromicized catgut. It took longer than twenty or twenty-five days to get union between the conjoined tendon and Poupart's ligament. In reply to the remarks of Dr. Coley, he would say, that he knows, that Dr. Coley uses kangaroo tendon as suture material, which may more properly be classed among the unabsorbable sutures.

Dr. Gerster said that perhaps twenty-five years ago he used silk exclusively as a suture material and for a time found it very satisfactory, until he had a series of infections which were traceable to imperfect technic in the preparation or handling of the sutures. Since then he had relied on chromicized catgut. At his division at Mt. Sinai Hospital, where hernia cases were operated on by five different surgeons, results, on the whole, had been very favorable. Personally he did not entirely accept the explanation given by Dr. Moschcowitz for occasional recurrences, and was inclined to attribute them, not so much to the technic or to the suture material, as to the natural tendency of the tissues of some patients to be non-resistant and flabby. Such tissues give way easily. With the very first stroke of the knife we could often recognize this inherent quality of the tissues—whether friable or tough. Some tissues tore readily, and it was probably this quality that was responsible for the original development of the hernia. While there were other factors, no doubt, this was one of the features that should not be disregarded.

Dr. Lusk said that since the last meeting of the Society, when his case of transplantation of the rectus muscle by a special technic was first briefly described by him, he was told by Dr. Hotchkiss that he likewise had for some years practised suturing a flap from the front of the rectus sheath, as well as the rectus muscle, to Poupart's ligament, and that the operation was original with Drs. Halsted and Bloodgood. Dr. Lusk said that in the meantime Drs. Halsted and Bloodgood had kindly supplied him with the literature on the subject. Wölfler (*Beiträge z. Chir. Festschrift f. Th. Billroth,* 1892, p. 552) was the first to transplant the rectus muscle, which he did through an anterior opening in the sheath. Bloodgood (*Johns Hopkins Hosp. Bulletin,* May, 1898, and *Johns Hopkins Hosp. Reports,* vii, 1898-99) without previous knowledge of Wölfler's operation transplanted the rectus muscle through a posterior opening in the sheath. Then Halsted (*Johns Hopkins Hosp. Bull.,* August, 1903), in 1899, in a case in which the internal oblique was " fatty and attenuated," used for the first time a part of the aponeurosis covering the rectus muscle to close the lower part of the inguinal canal. After 3 years the closure was still solid. Berger (*Revue de Chirurgie,* January, 1902) almost simultaneously with Halsted sewed a flap taken from the front of the rectus sheath to Poupart's ligament, in operating for inguino-interstitial herniæ. His flap was 8 to 10 cm. in length, and to support the area weakened by the cutting of so large a flap, the outer edge of the rectus muscle was sutured to the displaced outer edge of the sheath, and the relaxed overlying aponeurotic structures were apposed by a special plastic procedure. Afterward Bloodgood (*Internat. Clinics,* vol. i, 18th series, 1908, p. 296) revised his method of rectus transplantation, adopting the triangular flap from the front of the rectus sheath devised by Halsted, transplanting the rectus muscle now through this anterior opening in the sheath, and suturing the flap from the sheath and the rectus muscle each to Poupart's ligament by a separate row of sutures.

Regarding tension on the sutures uniting the internal oblique fibres to Poupart's ligament in indirect herniæ, Dr. Lusk said that Dr. Halsted (*ibid*) overcame this difficulty when present, by a vertical relaxation cut through the front of the rectus sheath.

Dr. Schley, in closing, said that what he wanted to emphasize was that the amount and extent of internal oblique muscle should determine the method of operation. The indication for rectus transplantation or transposition was deficiency of the internal oblique of such a degree that proper protection could not be secured with the straight Bassini. In certain cases where enough oblique muscle was present to be worth utilizing internal to the transplanted cord the combined operation was of value. In *marked* oblique deficiency the rectus sheath could be opened anteriorly, by the method he had spoken of, a quick simple procedure.

He was not in favor of using a non-absorbable suture when the absorbable would do the work and then disappear.

LYMPHOCELE SIMULATING FEMORAL HERNIA.

Dr. William B. Coley presented a boy, nineteen years old, who consulted him on February 21, 1913, with the history of having always been in good health up to two years ago, when he noticed a small swelling in the right femoral region. This had gradually increased in size and had never been reducible either on lying down or on pressure. It had never caused any pain. He had been examined in the out-door department of one of the leading hospitals in New York a few days before, and the condition was pronounced a femoral hernia by two surgeons, who advised an operation.

Examination showed a tumor in the right femoral region, two by three inches in diameter, situated directly over the femoral opening. The tumor extended outward, over and beyond the femoral vessels, and downward about three inches. The overlying skin was normal. The tumor was irreducible on pressure. There was no direct impulse on coughing; only a transmitted impulse. Palpation showed the swelling to be unlike that of a femoral hernia, in that, instead of a single pouch or sac, it appeared to be made up of a series of small lobules or cysts, and gave an impression not unlike that of a lipoma. The lobules were more or less loosely connected.

Dr. Coley said that while he felt positive that the condition was not a hernia, he was uncertain as to its actual nature, but he was inclined to believe it was a lipoma, and advised operation. After twenty-four hours rest in bed there was a considerable decrease in the size of the tumor, which added still more to the uncertainty as to its nature. Upon incision, he found a tumor made up of numerous small cysts or dilated lymph spaces extending up to the femoral canal. As many as possible of these were removed and the wound was closed without drainage. It healed by primary union.

After the patient left the hospital the swelling soon reappeared and had steadily increased in size until at present it was nearly two-thirds as large as it was at the time of the operation.

Dr. Coley said that in nearly 100,000 cases of hernia observed at the Hospital for the Ruptured and Crippled since 1890, no similar case had been seen, so far as he was aware.

Dr. Henry H. M. Lyle said that at a meeting of the Society in October, 1912 (vol. lvi, page 942), he showed a case of bilateral femoral adenolymphocele of filarial origin. The patient was a negro, twenty-one years old, from St. Kitts, West Indies, who four years previously had noticed a lump in each groin. The swellings were soft, painless, disappearing on lying down and reappearing on standing. During this time he had also suffered from periodical attacks of pain in the lower abdomen, and during one of these he was operated on for acute appendicitis in some hospital in this city. He obtained no relief from the removal of his appendix. There was no history of chyluria. The periodicity of the attacks had led to the diagnosis of malaria, while the abdominal pain had suggested appendicitis, diverticulitis, etc. Later, with greater prominence of the femoral swellings, the diagnosis of femoral hernia and strangulated femoral hernia were made. Upon further examination, however, and after several blood tests, microfilaria were found in the blood, and the diagnosis of adenolymphocele was made and the glandular masses in both groins excised. The lymphatics were greatly enlarged and it was found necessary to tie and cauterize a number of the lymphatics to check the escape of fluid. The wounds healed by primary union and there was no resulting lymphorrhœa nor elephantiasis.

Dr. Lyle said that upon looking up this subject more thoroughly, he felt that the best method was to avoid operating in these cases.

Dr. Darrach said he recalled one case where upon operating for a supposed inguinal hernia they found a large mass of lymphatics instead. The filarial organisms were not discovered in that case.

TRAUMATIC ERB'S PALSY IN ADULTS.

Dr. Alfred S. Taylor and Dr. Louis Casamajor read a paper with the above title for which see page 577.

Dr. F. Kammerer said his experience with three cases of Erb's palsy had been a rather discouraging one. In all of his cases there was avulsion of the brachial plexus. One was that of a young man who fell from his bicycle, striking on his head and shoulder. The second was that of a young woman who was thrown from an automobile, and the third was that of a man about thirty-five, who was struck upon the shoulder by a heavy load. In all of his cases there was complete motor and sensory paralysis of the entire extremity, and the patients came under his observation several months after the occurrence of the injury.

In operating on these cases, Dr. Kammerer said, he had made an incision along the posterior border of the sternocleidomastoid, continuing it along the clavicle in an outward direction, and finally passing over the clavicle into the axilla. The clavicle was divided in its outer half. Although this incision gave a large exposure, in none of his cases was he able to find the central ends of the nerves so that a satisfactory suture could have been applied. Only in the last case was he able to identify the short stumps of the third and fourth cervical nerves, to which he sutured the peripheral ends of the plexus. In one of the cases, after a most painstaking dissection, no nerve-ends were found issuing from the spinal column and no attempt at suture was made.

In the last case a few strands were found coming from the spinal column at one point, but the final suture was at the ends and seemed to hold out little promise of success.

These three operations had been done four and five years ago and up to the present moment very little improvement, if any, had followed in the two cases in which suture had been attempted. The speaker had been impressed by the great difficulty in dissecting out the scar-tissue, when several months had elapsed since the injury, and he thoroughly agreed with Dr. Taylor that an early operation should be done if better results were expected.

Dr. Charles H. Peck said his experience with this condition was limited to a single case, that of a patient who came to him two years ago last October, and whom—if he remembered rightly—he showed at a meeting of this Society shortly afterward. The patient was a professional bicycle rider who sustained a fracture of the clavicle, and when Dr. Peck saw him, five weeks later, there were evidences of complete paralysis of the fifth, sixth and seventh cervical nerves. Upon exposure, these nerves were found to be completely torn across just outside the intervertebral foramina, and after dissecting out the cicatricial tissue he was able to do a fair approximation of the fifth and the sixth nerves, but not of the seventh, which he finally succeeded in implanting into the eighth. For several months after the operation there was no functional improvement. It was now about two and a half years, and when Dr. Peck last saw the patient, perhaps a month ago, he found that the tone and function of the muscles had been regained to a very great extent; he was still unable to abduct his arm, but the atrophy of the deltoid had disappeared and it contracted strongly; the same was true of the extensors of the wrist, though the wrist drop was not entirely overcome. Regeneration of biceps and brachialis was practically complete.

Dr. Howard Lilienthal said Dr. Taylor made no mention of the immediate repair of these injuries, merely stating that the operation should be done at the earliest moment after the effects of the original traumatism had subsided. Personally, the speaker said, he had had no experience with these cases, but he saw no good reason why we should not follow the ordinary surgical rules and operate immediately after the injury, cleaning out the blood clots and doing an immediate repair.

Dr. Kammerer thought a distinction should be made between those cases that were associated with a skeletal injury, such as a fracture of the clavicle, and those that were not.

Dr. Taylor, in closing, said that in cases like those referred to by Dr. Kammerer, where the roots were apparently torn out of the foramina, the outlook was very bad. While it was desirable to operate early in these cases, Dr. Taylor said he had never seen a case earlier than the eleventh day, and we were more apt to see them much later, as the injury was so frequently unrecognized, and these patients floated from one clinic to another.

THE RIB-FINDER.

Dr. Theodore Dunham showed an instrument, which he had devised for the purpose of facilitating the resection of a rib. It steadied the tissues over the rib, arrested hemorrhage while the soft parts were being cut, and guided the knife from the time of the incision of the skin to the severing of the periosteum along the middle of the rib.

The instrument was composed of one solid piece of metal, and he said the description of it would perhaps be most intelligible if it were regarded as being made up by the assembling and soldering together of four pieces. Two strips of flat brass were laid parallel to one another and rotated in opposite directions until two of their edges were about one-eighth of an inch apart, while the other two edges were about three-fourths of an inch apart. The strips were given a slight curve, while their parallelism was maintained. These strips were now joined together at their extremities by two pieces of flat brass which entered slots cut in the strips. Soldering made the four pieces of metal one.

The principle of the instrument was that when it was pressed firmly upon a rib it would seat itself with considerable rigidity upon the rib, and the slot of the instrument would over-lie the middle of the rib. Hence the knife, cutting in the slot, would find its way directly to the bone of the rib, making one clean cut without shifting of the tissues, very rapidly and without hemorrhage until the instrument was removed, when any vessels could easily be caught. The slight curve in the instrument adapted it sufficiently to the curve of the ribs. The narrower face of the instrument was intended for cases where the ribs were small; the larger face for cases where the ribs were broader. In making a fairly long incision it was well, on account of the cylindrical shape of the chest, to rock the instrument, so that the greatest pressure would be at the point where the knife was cutting.

Dr. Dunham said he devised this instrument over three years ago and had used it in more than twenty cases of rib resection for empyema. It had never failed to guide his knife to a rapid and clean division of all the tissues down to the rib.

Stated Meeting, held at the New York Post-Graduate Hospital, May 14, 1913.

The President, Dr. Charles L. Gibson, in the Chair.

RUPTURE OF THE LIVER IN A CHILD.

Dr. John F. Erdmann showed a boy, six years old, who was admitted to the Gouverneur Hospital with the history that he had been run over by a truck. Examination showed a rapid pulse and marked abdominal tenderness. Within two hours after the receipt of the injury, Dr. Erdmann opened the abdomen through a median incision above the umbilicus, disclosing a rupture through the right lobe of the liver. This was repaired with several stitches and the abdomen then closed without drainage. Recovery was uneventful.

RUPTURE OF THE JEJUNUM IN A CHILD.

Dr. Erdmann presented a boy, six years old, who was admitted to the hospital with the history that while running he stumbled, and as he fell, he was thrown against a piece of projecting timber. The blow was received directly over the region of the umbilicus. The case was regarded as one of rupture of the ileum or jejunum. Exploration of the abdomen revealed a perforation of the jejunum, twelve inches from its origin, and upon exposing the appendix it was found to be œdematous and was removed. The jejunal opening was closed. The abdomen was drained for 48 hours.

PARTIAL GASTRECTOMY: POSTERIOR GASTRO-ENTEROSTOMY.

Dr. Erdmann presented a man, fifty years old, a druggist, who entered the Post-Graduate Hospital on April 14, 1913, with the history that for the past 25 years he had suffered from indigestion, with nausea and inability to retain certain vegetables. At times the nausea was associated with pain. His symptoms gradually became more aggravated until he was unable to take any solid food without experiencing severe pain in the region of the pit of the stomach, which would be relieved by vomiting.

Operation, April 22: Upon opening the stomach, a tumor was found at the pylorus, with marked infiltration of the pyloric area. A partial gastrectomy and posterior gastro-enterostomy were done. The patient was discharged, at the end of 3 weeks, able to take all kinds of food.

CARCINOMA OF THE PAPILLA OF VATER: CHOLECYSTOSTOMY: POSTERIOR GASTRO-ENTEROSTOMY: CHOLECYSTENTEROSTOMY.

Dr. Erdmann presented a machinist, forty-six years old, who entered the Post-Graduate Hospital on December 30, 1912, complaining of pain and vomiting after meals. His present illness dated back about three months, with pain in the epigastrium and vomiting, coming on from a few minutes to a few hours after taking food. The pain was located in the median line; it was colicky in character and was always relieved by vomiting. No blood had ever been observed in the vomitus, which consisted of previously ingested food, with mucus, with the occasional addition of a large quantity of greenish material. His symptoms gradually increased in severity until the pain would come on immediately after taking food of any character, only to be relieved by vomiting. The patient had lost 20 pounds in weight during the past three months.

An examination of the blood showed 7000 leucocytes and was otherwise negative, as was also the urinary examination and the Wassermann. An analysis of the gastric contents showed considerable retention, with a total volume of 275 c.c.; free hydrochloric acid, 19; combined, 9; total acidity, 36; no blood. The fluoroscopic examination, made by Dr. L. Kast, showed evidences of marked gastric retention, and an obstruction of some kind, probably a tumor, in the duodenum, the first portion of which was markedly dilated, with the hepatic flexure drawn between the duodenum and the median line. From these findings, Dr. Kast made the diagnosis of stenosis of the mid-portion of the duodenum.

Operation, January 14, 1913: This revealed a marked dilatation of the pylorus and the first portion of the duodenum, with an annular constriction of the duodenum at the ampulla of Vater. The gall-bladder was greatly dilated with fine biliary sand. A cholecystostomy and posterior gastro-enterostomy were done, and the patient left the hospital twenty-one days later, apparently well. Two weeks later he had a discharge of bile from the healed cholecystostomy wound, with the development of jaundice. He was re-admitted to the hospital on April 11, and when the abdominal wound was re-opened it was found that the tumor, which had constricted the jejunum, had become mushroom-like in its growth and about three times its original size. A loop of jejunum was brought out and anastomosed to the gall-bladder—cholecystjejunostomy. The patient left the hospital 4 weeks after the second operation with a gain of 20 pounds.

ACUTE PANCREATITIS: TWO CASES.

Dr. Erdmann presented a man, fifty years old, who after a history of gall-bladder disease dating back three years had a sudden attack of sharp pain, with profound jaundice and some cyanosis and dyspnœa. He was admitted to the hospital, and was operated on by Dr. Erdmann on the third day of his attack. Upon opening the abdomen, he found a hemorrhagic pancreatitis, with fat necrosis. A cholecystectomy and choledochotomy were done. A fistula (*mucus*) persisted for 18 months with spontaneous closure.

Dr. Erdmann's second case of acute pancreatitis was that of a man, thirty-five years old, who gave a history of very sharp abdominal pain, and upon admission to the hospital his temperature was 102°; pulse, 120. Upon opening the abdomen for a supposed appendicitis, free fluid was found in the peritoneal cavity. A median incision was then made higher up, revealing an acute pancreatitis, without any evidence of fat necrosis. Liberal drainage of the pancreas by puncture and a cholecystostomy were performed.

EXCISION OF REMAINS OF WOLFFIAN (?) DUCT.

Dr. Erdmann presented a man, a physician, whose family history was negative, and who gave no history of venereal trouble. In December, 1909, he had an attack of left pleuropneumonia, with effusion, and for six months following this illness he complained of vague pains in the back, with vesical tenesmus. His urine during this period contained pus, and a diplococcus (probably the pneumococcus) was more or less constantly present. The diagnosis of tubercular kidney was made at that time.

On July 7, 1910, the patient developed an acute septic condition, with chills and high temperature. He was seen by Dr. Erdmann, who found a large mass in the left iliac region. The prostate also seemed to be enlarged. A perineal section was done the following day and some pus evacuated. The perineal wound was re-opened twice during the summer and again in October, 1910, when a retention catheter was inserted, permitting free drainage. The tube was left in place for eighteen months, during which period the patient's general condition improved. The discharge from this opening was semipurulent, with a urinous odor, and was supposed to connect with a diverticulum of the bladder. It was treated by curettement and various instillations, but failed to close, and finally, on April 10, 1912, a radical operation was undertaken. The abdomen was opened through a transperitoneal incision, revealing a mass which extended from the prostate up to the diaphragm. It was about seventeen inches in length, gradually developing into a large tumor under the diaphragm, which resembled a cystic kidney. In dissecting it out, which was accomplished with great difficulty, the left ureter was unfortunately injured. Five weeks later the left kidney was removed. The patient still had a small sinus in the perineum which discharged slightly.

Dr. Erdmann said this specimen had been submitted to several pathologists, and various opinions had been given as to its nature. Some regarded it as the remains of the Wolffian duct, while others said they did not know what it was.

SKULL DEFECT, WITH TIBIAL GRAFT.

Dr. Robert T. Morris presented a man twenty-five years of age, who entered the Post-Graduate Hospital on April 4, with a depressed pulsating area at the site of an injury to the left frontal bone. Fracture of the skull had been produced at this point with a beer bottle some months previously, and some bone had been removed at the Bushwick Hospital in Brooklyn.

In order to remedy the skull defect, Dr. Morris had made a tibial transplantation, using a quadrangular segment about 1¼ inches long and 1⅛ inches wide, and fitting it into a corresponding space in the frontal bone. Primary union followed. The patient left the hospital two weeks later. Sixteen days after that, he returned with a transverse fracture of the tibia at the site from which the bone graft had been removed. While rising from a chair, with his left foot slightly flexed and abducted, he put his weight upon it and felt the tibia snap. Dr. Morris said that he had heard of four cases similar to this one very recently, and he believed it very important to give warning of the danger, now that tibial grafts are being used so extensively. The reason for the fracture at this point, where the bone would seem to be sufficiently strong, was due to the mechanical feature of destruction of the reed principle, when a segment of the firm outer layer of the reed had been removed. The patient is now comfortable with a plaster-of-Paris splint, and the radiograph showed the fragments in perfect position.

OSTEOPLASTIC OPERATION ON THE FOOT FOLLOWING INJURY.

Dr. Morris presented a civil engineer, twenty-five years of age, who entered the Post-Graduate Hospital on February 14 with ankylosis of the right ankle-joint. Two years before, the foot had been injured in a street car accident, and the patient had been treated with a plaster cast at the Toronto General Hospital for four months, good repair having been obtained so far as the compound fracture was concerned.

The radiograph taken by Dr. Cole showed that the astragalus had been displaced, presenting its short axis in the line which should be occupied by the long axis. Dr. Gibney had seen the case in consultation and advised removal of the astragalus. When an incision had been made for the purpose, Dr. Morris found that he could not enucleate the astragalus because the entire joint was filled with fibrous and bony exudate. Consequently, he had removed a V-shaped wedge which included not only the astragalus, but parts of adjacent bones, and this allowed of correction of the talipes and the obtaining of a foot upon which the patient had been able to play a game of base ball recently.

CÆCOSIGMOID ANASTOMOSIS.

Dr. Morris presented a man, twenty-three years of age, who entered the Post-Graduate Hospital on January 16, with a history that 13 years ago he was operated upon for appendicitis with abscess through a right lumbar incision. Details of the case at that time not known. Eighteen months after the first operation, another abscess formed and was operated upon. This wound also closed in about a month. The patient remained well for five years and then had a third attack. At this time his appendix was removed and the wound was closed. Two years later, a fourth attack with abscess led his physicians to believe that the abscess had been a psoas abscess from the start. The last wound remained open for a year, and when it closed, the patient suffered at once, requiring another opening.

When he entered the Post-Graduate Hospital, on January 16, it was supposed that the abscess was connected with carious bone, for the reason that there was no history of escape of gas or bowel contents from the fistula, which was believed to be a sinus. A bismuth picture having been obtained, however, showed that there was indirect connection with the cæcum, intra-abdominal pressure making a sort of valve of the cæcum. The entire fistulous tract was laid open and an attempt made at closing the bowel opening. This failed. Dr. Morris then made a midline incision and found that the cæcum was of the mobile type, lying nearly in contact with the sigmoid. A cæcosigmoidostomy was done. This had relieved the patient from his distress and from his constipation. The site of the old sinus was at the present time filling with granulation.

NEPHRECTOMY FOR HYPERNEPHROMA.

Dr. Willy Meyer presented a woman, fifty-seven years old, who was admitted to the German Hospital on June 24, 1912, with the history that two years ago she had a sudden severe pain in the region of the mid-abdomen, followed by the appearance of blood in the urine, and on the following day she noticed small, stone-like particles in the urine. Since then she had suffered more or less constantly from hæmaturia, the blood usually being clotted and dark red in color. Micturition was usually painless, but was at times accompanied by a steady, non-radiating pain in the right abdomen. She was obliged to pass urine frequently and had an almost constant desire to micturate. A few days ago she had two passages of blood from the urethra within 24 hours, with pain in the right side of the abdomen and in the urethra which lasted about fifteen minutes. The urine passed between the hemorrhages was clear.

The patient complained of shortness of breath, and that her feet occasionally swelled toward evening. There was cardiac palpitation at times, with frequent headaches. The bowels were regular. The appetite was poor. In the left hypochondriac region a firm mass was made out. It was smooth in outline, about four by six inches in size, with its longest diameter extending diagonally downward and inward from the mid-axillary line. It was most prominent just below the costal margin, where it felt tense and smooth. It was freely movable and could be pressed downward and inward so that its lowest pole could be felt one inch to the right and below the umbilicus. It was slightly tender near its lower margin, and moved freely with the movements of respiration. Upon inflating the colon, it was found that the large intestine lay above the mass and pushed it to the left side. A vaginal examination showed nothing abnormal. The cystoscope showed the bladder mucosa normal. The ureters were not catheterized.

Operation, June 29, 1912: A vertical incision was made, about six inches long, beginning an inch and a half from the spinous process on the right side and the kidney exposed. From about the centre of this incision, extending diagonally downward and forward toward the mid-line of the body, a second incision was made so as to fully bring to view a large retroperitoneal mass which apparently involved the kidney. This mass was stripped from its capsule and removed. During its removal, the peritoneum was opened. This was closed with a continuous plain catgut suture, also the mesocolon of the descending colon, which had been longitudinally incised. The skin wounds were then closed, and the patient made an uneventful recovery, and was discharged on August 15, 1912. To-day there is no sign of recurrence; patient has considerably gained in weight, is in perfect health.

Dr. Meyer presented a woman, thirty-five years old, a domestic of Irish birth, who was admitted to the German Hospital on May 15, 1912, with the history that she had always been well until the previous December, when she had an attack of vomiting, with pain in the upper abdomen, which lasted for a few days. The following month she had a similar attack and after this they were of more frequent occurrence and lasted for a week or ten days. The vomiting occurred, usually, in the morning and was accompanied by cough, but no sputum nor blood. Her last attack occurred about a week ago. The vomitus consisted of food she had taken. She was told that she had an ulcer of the stomach. She denied the excessive use of alcohol.

About a week prior to the patient's admission to the hospital she had a dull pain in the left portion of the abdŏmen, and at the same time she noticed a large mass there. This remained unchanged in size and gave rise to an uncomfortable sensation rather than actual pain, excepting when she lay on the right side. The bowels were constipated; appetite good. The patient thought she had lost much weight recently, and seemed poorly nourished.

Examination of the abdomen showed a firm mass on the left side. The skin covering it was freely movable, as was the mass itself, which on deep inspiration seemed to slip for several inches beneath the abdominal wall in a supero-inferior direction. The dulness of the growth appeared to be continuous with that of the liver. It could be moved slightly from side to side, and was visible, especially laterally and from below, and extended to the left flank. Its outline was smooth and well defined; not nodular. There was no distinct fluctuation. There was slight tenderness upon pressure over the mass posteriorly. When the colon was inflated the mass appeared to be forced to the left; its dulness was not diminished, and the colon seemed to lie inferiorly to the mass. The tumor was oval in shape, with its longest supero-inferior diameter about five inches long and its lateral diameter about four inches.

Operation, May 25, 1912: An incision was made on the left side extending from the twelfth rib for about five inches through the muscles and the fatty capsule of the kidney. A large cystic mass was found in the depth of the wound. A second incision was then made approximately at right angles to the first, extending across the left side of the abdomen and partly on its anterior surface. The mass was then removed from its capsule and the pedicle ligated with strong silk. The wound was closed, with split-tube drainage. The patient made an uneventful recovery and left the hospital on July 24, 1912. She also is in excellent condition to-day.

IDEAL CHOLECYSTOTOMY (KOENIG'S INCISION).

Dr. Meyer presented a woman, a housewife by occupation, thirty-six years old, who entered the German Hospital on May 20, 1912, who for the past year or so had suffered from attacks of severe, cramp-like pains in the right abdomen. The pain came on suddenly, commencing on the right side of the back and radiating downward and forward on the abdomen. There was no rigidity of the abdomen, and no masses could be felt. There was an area of tenderness extending from the mid-axillary line under the costal border to the right mid-clavicular line on a level with the umbilicus.

The case was regarded as one of cholelithiasis, and on June 10, 1912, Dr. Meyer exposed the gall-bladder through a Koenig incision, beginning about an inch below the costal margin on the right side, extending across the right rectus and then upward toward the ensiform in the midline. Only the inner three-fourths of the right rectus were divided, together with its posterior sheath and the peritoneum. This semilunar incision gave excellent access to the gall-bladder, which was found to be soft and pale, and containing one large stone. The bladder was opened and the calculus extracted. The wound was then closed by a double row of sutures, and the patient made a good recovery.

In this case the appendix was found to be the seat of a subacute suppurative inflammation, and it was removed before doing the cholecystostomy. The abdominal wound was carefully closed by large sutures. At present the patient shows no symptoms of disease and is apparently cured. The abdominal scar is firm.

PYLORIC ADHESIONS AND APPENDICITIS (KOENIG'S INCISION).

Dr. Meyer presented a woman, forty-one years old, who was admitted to the German Hospital on April 25, 1912, with the history that for about four months she had suffered from pain in the abdomen. This was intermittent in character, beginning under the xiphoid cartilage and radiating toward the right. She had vomited occasionally, usually after meals. The vomitus had never contained blood.

Examination of the abdomen showed slight rigidity, without distention, most marked under the xiphoid cartilage, and in this area there was marked tenderness on pressure, which extended along the right free border of the ribs and was also present in the region of McBurney's point.

Operation, May 13, 1912: A semilunar (Koenig) incision was made across the upper border of the right rectus and linea alba, and the rectus muscle and sheath divided transversely. The gall-bladder was not distended, but there were rather broad and firm adhesions between the gall-bladder and stomach. These were divided between double ligatures. No sign of duodenal or gastric ulcer.

The appendix, which was directed upward behind the cæcum, was rather long, but neither congested nor swollen. It was attached to the mesentery of the cæcum. The appendix was removed, the wound closed, and the patient made a good recovery. She is well to-day. Dr. Meyer considers Koenig's incision, same as that recently recommended by Perthes, a step forward, inasmuch as both avoid the injury to the nerve branches of the right rectus muscle. A paresis or partial paralysis of the upper portion of the latter cannot set in as it sometimes occurs with the longitudinal division of the muscle, so much in use in gall-bladder surgery.

RESECTION OF THE ABDOMINAL WALL FOR RECURRENT TUMOR IN A HÆMOPHILIAC: PREVENTIVE INJECTION OF HUMAN BLOOD SERUM: RECONSTRUCTION OF ABDOMINAL WALL BY SILVER WIRE FILIGREE.

Dr. Meyer presented a man, thirty-six years old, a cigar-maker by occupation, who was admitted to the German Hospital on January 7, 1913, with the history that about six years ago he noticed a small lump under the skin to the right of the umbilicus. During the first two and a half years this tumor gradually increased in size until it was as large as an infant's head. It was removed, only to recur in the same location about fifteen months later, and a year and a half ago it was again removed. Since then there had been a swelling within the abdominal wall of about the size of an orange, in the region of the gall-bladder transgressing the middle line, and a smaller tumor at the lower end of the operative wound over the bladder region. These growths were absolutely painless and gave rise to no symptoms. There was no loss of weight and the patient otherwise appeared to be in excellent health. Diagnosis: recurrent fibrosarcoma.

First operation, January 21, 1913: Upon exposing the suprapubic tumor it was found to be adherent to the peritoneum; it could be excised without opening the latter. The extensive gap in the abdominal wall was closed with the aid of a silver wire filigree, made in the spot. Cable silver wire was used. On several occasions after the operation, the dressings were found to be saturated with blood. It was then learned that the same had been observed in the two previous operations and the patient was pronounced a hæmophiliac. It took more than ten weeks before the wound had closed by granulation. The wire had to be removed.

Before attacking the tumor above, preparatory hypodermic injections of human blood serum were administered about ten ounces in all, the blood having been derived from a healthy relative of the patient. On April 28 the abdominal wall in the right hypochondriac region was excised in its entire thickness, excepting the skin, and as large as the palm of the hand. On inspection a large infiltrating tumor was found in the liver. Another organ was not affected. It was deemed inadvisable to remove a portion for diagnosis. Now the omentum was spread out and stitched to the borders of the large defect and the gap covered by a filigree of various sizes of cable silver wire. On top of this the skin was closed without drainage. Primary union followed, a secondary hemorrhage did *not* set in. The abdominal wall appears perfectly firm. Pathologically the growths were pronounced rhabdomyomata, clinically they had to be considered fibrosarcoma. It will be interesting to observe the further course, particularly on account of the tumor of the liver. The case proves again the effectiveness of the injection of blood serum to overcome the dangers of an existing hæmophilia.

ULCER OF THE DUODENUM: PYLORIC EXCLUSION.

Dr. Meyer presented a woman, forty-two years old, who had suffered from gastric disturbance for a number of years. Medical treatment has been thoroughly tried without lasting result by Dr. Max Einhorn, who diagnosed duodenal ulcer. On November 13, before the Congress of American Surgeons at the Post-Graduate Hospital, the abdomen was opened and a distinct infiltrating ulceration found. The stomach was divided transversely, Hueltl's wire-stitching instrument being used for suturing and placing a double row of wire staples for occlusion of either end at the same time; then both stumps were inverted by a single running suture of silk. Posterior gastro-enterostomy was then added. Convalescence was uninterrupted, with normal temperature from the beginning. To-day patient states to be materially benefited, though not yet entirely free from trouble.

ECHINOCOCCUS OF THE LIVER.

Dr. Meyer presented a woman, twenty-eight years old, an Italian by birth, who was also operated on at the Post-Graduate Hospital. There was a large, bulging mass with smooth surface and evidently deep fluctuation below the right costal arch, passing upward and underneath the same, clearly a cystic tumor (echinococcus) of the liver. The abdomen was opened by a rectus incision. The wall of the cyst in the liver was calcified; there were quite a number of cyst-like irregular spots in the liver. After closure of the abdominal wound up to the liver and careful tamponade, the cyst was tapped and then incised. It contained typical clear echinococcus fluid and a great many daughter cysts of various size, with masses of coagulated material. The wall of the cyst was stitched to the parietal peritoneum and the large cavity amply drained. About twelve weeks after the operation the cyst's wall was discharged in one mass and it now seems that the patient will be cured. She is still at the hospital.

TOTAL ANKYLOSIS OF THE LOWER JAW FOR TWENTY-TWO YEARS: BILATERAL RESECTION OF THE CONDYLOID PROCESSES.

Dr. Meyer presented a man, twenty-eight years old, who when he was six years of age fell on his chin. Not long afterward his trouble began. As long as he can remember he was unable to open his mouth. When first seen, patient showed the typical symptoms of micrognathia. Lower jaw much arrested in development, anterior curve of bone at least one inch inward of that of the upper jaw; teeth of inferior maxilla grown forward in oblique direction, as seen in a horse, but their crowns do not meet their opponents; all teeth are present and in good condition; there is a space of about one-sixteenth of an inch between the two rows of incisor teeth. The jaw's articulation with the temporal bone appears to be totally ankylosed on both sides. One is able to palpate a broad bony mass in front of each external auditory meatus. X-rays corroborate this condition. Operation, done eight weeks ago, demonstrated the total absence of a mandibular joint on either side. A large bony mass, one and a half inches wide, thick, eburnated took the place of the condyloid and coronoid processes. A large piece of the bone was resected bilaterally, a flap of fascia or muscle was not turned into the resulting cavity, because the wound, had to be tamponed (with sutures placed, but not tied), on account of rather profuse hemorrhage. Tampons were removed and wounds closed 48 hours later. To-day patient can open his mouth nicely, although the muscles, which have to pull the jaw downward are not developed. The next step is removal of the lower molars with chisel and a prothesis with a set of lower teeth, attached to those present, which will enable the patient to masticate.

WIRING OF AORTIC ANEURISM.

Dr. Meyer presented an Italian, fifty-seven years old, who was admitted to the German Hospital on July 26, 1912, with the history that for the past two years he had suffered from pain in the chest, with dyspnœa and a more or less constant cough. He had sciatica sixteen years ago, and a chancre a year later. He was under treatment for syphilis for only two weeks.

Examination of the chest showed an area of cardiac dulness extending from the first to the fifth interspaces, both to the right and left of the median line, with marked pulsation, which could be seen and felt. The apical impulse was not palpable and the heart sounds were scarcely audible. But there was a loud bruit. A diagnosis of aortic aneurism was made, which the X-ray findings confirmed.

The patient was kept under observation on the medical division for several months, and was treated with mercurials and salvarsan, with very slight improvement in his symptoms. He still complained of pain, and suffered from cough and dyspnœa. On November 17, 1912, Dr. Meyer introduced into the aneurismal sac thirty-two feet of gold-platinum wire, through which an electrolytic current was then passed to hasten the formation of a clot. The technic followed was that described by Dr. William C. Lusk. Following this operation, there was marked and rapid improvement in the patient's symptoms, and he was discharged on January 12, 1913. A stereoradiographic examination made on the day prior to his discharge showed the wire in the aneurismal sac, with no perceptible change in the size of the latter. Having been bedridden before, he can now walk up four flights of stairs. Wassermann test being still four plus, further treatment with salvarsan is indicated.

INTRATHORACIC CARDIOPLASTY FOR INTRACTABLE CARDIOSPASM: SECONDARY THORACOTOMY.

Dr. Meyer presented a man of forty-four, in good general condition, who had long suffered from intractable cardiospasm. He regularly regurgitated about two-thirds of each meal, and asked for operative relief. In May, 1911, bilateral vagolysis and single plication of the œsophageal fourth had been done, with rapid recovery and temporary marked improvement in swallowing. Gradually the former trouble had returned, very likely in part due to the scar formation around the lower portion of œsophagus and the cardia. Patient asked for further operative treatment in spite of possible dangers connected with such work, which were thoroughly explained to him.

On February 13, 1913, Dr. Meyer opened the thorax for the second time and did an intrathoracic cardioplasty. The left eighth and ninth ribs, together with the intercostal tissues, were excised, giving wide access. Then, with the tips of the fingers, the lung was gradually loosened from the lateral chest wall, and the rather firm adhesions also those to the diaphragm were put on the stretch and cut close to the latter in order to avoid injury to the lung tissue. The region of the œsophagus was now well exposed, but firm scar tissue was met with next to the aorta; this was incised, and the finger gradually worked around the œsophagus. This was very difficult and time-consuming, but was finally successful. The pneumogastric nerves which were firmly adherent to the œsophagus, were again carefully loosened and pushed aside, the aorta loosened, and a cardioplasty made according to the Heinicke-Mikulicz method at the pylorus. The old scar tissue interfered much with this work, as only about one inch of the cardiac portion could be pulled upward. The longitudinal incision of the œsophagus, one inch long, was then stitched in the transverse direction by two rows of sutures and the wound covered by a free fascia transplant from the fascia lata of the left thigh. Recovery was slow, but continuous, patient is still under treatment. Swallowing is much improved.

CANCER OF THE ŒSOPHAGUS: JIANU'S GASTROSTOMY AND INFERIOR ŒSOPHAGOPLASTY.

Dr. Meyer presented three patients operated on by him by this method recently. The procedure was carried out with needle and thread throughout (one patient), and also, when cutting out and forming the Jianu tube, with Hueltl's wire stitching instrument (two patients). See article on œsophagoplasty, Annals of Surgery, September, 1913.

PNEUMOTOMY FOR LOCALIZED BRONCHIECTASIS AND GANGRENE.

Dr. Meyer presented a woman, twenty-eight years old, with localized gangrene of the right upper lobe following a severe ether (aspiration) pneumonia after extirpation of an ovarian cyst. When seen there was high fever and very foul smelling expectoration. The disease could be well located by clinical examination and X-rays. Operation, March, 1910, with patient's head in plus pressure cabinet, should differential pressure have become indicated. It was not required during operation. Resection of second and third rib with cartilage, intercostal tissue removed. Lung cavity opened with cautery, finger introduced and a number of intervening walls broken through bluntly. Pus found; no hemorrhage; drainage. A year after operation the fistula closed. To-day patient is in splendid condition.

THORACOPLASTY AND DELORME'S OPERATION FOR FISTULA FOLLOWING EMPYEMA.

Dr. Meyer presented a boy, sixteen years old, who gave a history of pneumonia, with empyema, ten months ago. A resection of one rib was done, which resulted in a persistent fistula. The resulting cavity was repeatedly injected with bismuth, followed by bismuth poisoning and irregular fever.

The patient was seen by Dr. Meyer in December, 1912. After raising a skin-muscle flap, he excised a section of the chest wall involving five ribs. The pulmonary pleura was thin, and was peeled off, and a tamponade inserted. The patient made a good recovery, and was now in perfect health.

THORACOPLASTY FOR CHRONIC EMPYEMA.

Dr. Meyer presented a man, twenty-five years old, who gave a history of right-sided pneumonia two years ago. This was followed by an empyema for which he was operated on three times. There was an obstinate fistula near the spine, between the ninth and tenth ribs, and the probe and X-ray revealed a tube-like cavity adjacent to the spinal column and extending up to the second rib.

In March Schede's incision, scapula turned up, and second to fourth ribs inclusive resected in their posterior half. Good convalescence; still under treatment.

The X-ray plates of three last patients were exhibited.

LIGATION OF BRANCHES OF THE RIGHT AND LEFT PULMONARY ARTERY FOR BRONCHIECTASIS.

Dr. Meyer showed three cases of bronchiectasis in which he had performed this operation under differential pressure (see Annals of Surgery, August, 1913, pages 197–200).

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held May 5, 1913.

George G. Ross, M.D., in the Chair.

ACUTE GASTRIC DILATATION FOLLOWING OPERATION FOR HERNIA.

Dr. John Speese presented a man, fifty-six years of age, who was operated upon at the Presbyterian Hospital for an incomplete inguinal hernia by the Bassini method. The patient recovered consciousness readily and experienced but slight nausea from the ether. Thirty-four hours later, after drinking a small quantity of milk, he complained of nausea, which gradually became more severe, and was followed by vomiting two hours later. Temporary relief was experienced, and no alarm was felt as the temperature, pulse and leucocytic count were normal and the abdominal muscles relaxed. The vomiting recurred, the fluid was dark in color, odorless and was ejected in small amounts without effort every few minutes. The patient then developed considerable abdominal pain, and on examining the abdomen at this time, the stomach was found greatly dilated, extending to the umbilicus, and partially filled with fluid, as determined by a succussion splash. A stomach tube was passed and several quarts of dark fluid withdrawn, and lavage performed. An abdominal binder was applied and the patient turned on his abdomen, a position he could assume only for short periods.

He was entirely relieved of the pain and vomiting for six hours, when the latter recurred in a less severe form. The same treatment was carried out and permanently relieved the condition. Examination of the stomach twelve hours after the vomiting began, disclosed a normal state of affairs, the dilatation having perfectly subsided. The patient was given salt solution by rectum to relieve his thirst, and small quantities of water by mouth were allowed twelve hours later without causing any disturbance.

Dr. Speese remarked that acute dilatation of the stomach may follow any variety of operation, although it appears to be relatively uncommon as a post-operative complication of hernia. Lyle (*N. Y. Med. Jour.*, 1911, xciv, 932) observed a case following the radical cure of a hernia, the operation was performed under local anæsthesia, and a large amount of omentum was resected. The dilatation began one hour after the operation, and in all probability was caused by the removal of the large amount of omentum which profoundly altered the circulation and possibly the nervous mechanism of the stomach, thus causing a temporary muscular paralysis.

The finding, at post-mortem, of constriction of the duodenum by the superior mesenteric artery at the point where it crosses the intestine, has naturally caused this factor to be regarded as of much importance in the etiology of the affection. That the constriction can be caused by an abnormally long mesentery or by ptosis seems unlikely, and is denied by Mathieu (*Arch. d. Mal. d l' App. Dig.*, 1911, v, 409) who regards the gastric dilatation as the primary factor. Distention of the stomach must take place in a downward direction, the intestines are compressed, the superior mesenteric artery is put on a stretch and the duodenum is thus constricted. The primary dilatation is caused by aërophagia, which is the result of the constant swallowing which follows the nausea and pharyngeal irritation induced by ether. This view seems feasible in the case reported as the patient complained of annoying thirst soon after his recovery from the ether and the constant swallowing must have been accompanied by the passage of a considerable quantity of air into the stomach. The dryness and irritation of the pharyngeal mucosa were moreover increased by a chronic nasal obstruction which made mouth breathing a necessity.

Dr. Edward B. Hodge said that recently, in the case of a woman, fifty-seven years of age, who developed pneumonia one week after operation for appendicitis, temperature was normal for two days, at which time she developed acute dilatation of the stomach; this was relieved after several lavages, but the patient finally succumbed to acute nephritis.

Dr. George G. Ross reported a case of dilatation of the stomach which occurred about the seventh day after an operation in an otherwise healthy young woman who had pus tubes. She had done very well until the night of the second day when she drank the contents of an ice-bag (about one quart). The next morning she had acute dilatation from which she promptly died in spite of all treatment; the water from the ice-bag being the supposed cause.

RETROPERITONEAL ABSCESS.

Dr. Speese reported the history of a child, eight years of age, who was admitted to Dr. Jopson's service at the Presbyterian Hospital, complaining of pain in the right wrist and left thigh. One week before he had been struck over the left hip, and in several hours the leg became stiff. This increased to such an extent that in three days the boy could not walk, and the thigh became very tender on pressure. The wrist also began to pain considerably and was slightly swollen.

September 5, 1912, four days after the accident, when admitted he complained of abdominal distention, pain and swelling over the lower end of the radius. The region about the hip was very tender, there was slight swelling on the outer side of the femoral vessels, and pressure over the trochanter caused pain. The temperature was 103°, W. B. C. 15,000. Exploration over the trochanter by Dr. Speese revealed normal bone and no evidence of pus. The lower end of the radius was exposed and free pus was found under the periosteum which was raised, the cortex of the radius was chiselled and several drops of pus found in the medullary cavity.

September 7, 1912, the pain in the hip region continued, and the abdomen was markedly distended, tender, but not rigid. W. B. C. 21,000.

September 9, 1912, an area of fluctuation was detected in the left groin, below Poupart's ligament and to the inner side of the femoral vessels. A large amount of pus containing blood clot was evacuated, and on exploring the abscess cavity it was found to extend behind the peritoneum for a distance of four or five inches. The abdominal distention disappeared after evacuation of the abscess.

The cavity was drained, and closed slowly as the convalescence was prolonged by the formation of several pyæmic abscesses. The bacteriological examination of the pus showed staphylococcus aureus.

Instances of retroperitoneal abscess of this type are uncommon, and may cause considerable difficulty in diagnosis because of the symptoms suggesting an acute inflammation of the abdominal viscera. The origin of the abscess is not easy to explain, it seems rational to suppose that the primary process consisted in the formation of a hæmatoma, the result of the injury sustained. Subsequent infection occurred by bacteria derived either from the intestine or from the blood stream and abscess formation resulted. The same sequence has been observed in rupture of the liver or kidney, followed by hemorrhage into the retroperitoneal tissues.

Diffuse inflammation of the retroperitoneal tissues with pus formation may follow suppurative infections of the appendix, gall-bladder or pancreas. Sprengel (*Arch. Klin. Chir.*, 1912, c, 382) in a recent contribution has thoroughly reviewed the subject, and believes that the general peritoneal cavity in some instances may be uninvolved after appendicitis, for example, while a diffuse suppurative process may attack the retroperitoneal space. As a general rule the peritoneum acts as a barrier and prevents rupture of the pus into the abdominal cavity, but œdema of the mesentery and intestines, and a serous or blood-tinged effusion may result from the infection, and prove misleading when the abdomen is opened.

Sprengel refers to a case which resembles the one reported in many respects. The patient, a woman sixty years of age, sustained a fracture of the neck of the femur, and ten days later was seized with an attack of pain, vomiting and abdominal distention. The patient collapsed and death resulted on the eleventh day. The autopsy disclosed a suppurative para-proctitis which was regarded as the primary infection, and from this a fatal peritonitis arose. The rectal mucosa did not show any trace of injury from which the infection might have started.

The origin and formation of many of these infections is not clear. In children the diagnosis is difficult because of the possibility of an acute osteomyelitis of the femur, and because of the abdominal symptoms produced by pressure of the retroperitoneal effusion. That the disease is not so uncommon may be judged from the occurrence of this case, a second one a short time afterward in Dr. Rodman's service, and several of similar nature in Dr. Wharton's wards at the Children's Hospital.

Dr. J. Stewart Rodman recalled the particulars of a case which occurred at the Presbyterian Hospital, in the service of Dr. W. L. Rodman. The patient was a boy of ten who had been run over by a wagon three weeks previous to his admission to the hospital, thus giving a history of trauma more or less remote. The diagnosis was not altogether clear at first, as tenderness and fixation of the left hip suggested an acute tubercular arthritis. Later on, however, an easily palpable tumor appeared above Poupart's ligament on the left side which was quite tender to touch and accompanied by a septic temperature. The diagnosis of retroperitoneal abscess was now quite clear. This was opened extraperitoneally and the boy afterward made a rapid recovery.

PERFORATION OF ILEUM BY A FOREIGN BODY FOLLOWED BY SYMPTOMS SIMULATING APPENDICITIS.

Dr. Speese recited the history of a man, aged fifty-three, who was admitted to Dr. Jopson's service at the Presbyterian Hospital with the following history: Two days previously he experienced a sudden and severe pain in the right iliac region, this was accompanied by nausea and vomiting. The pain which continued until his admission to the hospital, gradually became more severe, the nausea persisted but the vomiting ceased; the bowels had not moved for two days. The leucocytic count was 24,500, pulse 92, temperature 99.4°. The abdomen was slightly distended, and on palpation the right rectus muscle was rigid, and pronounced tenderness was present over McBurney's point.

A diagnosis of acute appendicitis was made and the operation which was at once performed by Dr. Speese revealed many recent adhesions about the cæcum, a small amount of turbid fluid and fibrin, but a normal appendix. Believing that an inflamed Meckel's diverticulum might have caused the condition, the ileum was drawn out of the wound and examined. About four inches from the ileo-cæcal junction a foreign body was felt in the lumen of the bowel, one end being firmly embedded in the intestinal wall almost penetrating the serous coat. The body was extracted and was found to consist of a flat piece of bone, 4 x 1 cm., resembling a sequestrum, one end was splintered and as sharp as a needle. The intestinal wound was closed, examination of the surrounding coils of intestine did not reveal any evidence of perforation. The local peritonitis present was regarded as the result of a puncture of the intestine by the foreign body, the opening being small was soon closed by plastic lymph making its site difficult to discover. The abdomen was drained, convalescence was uninterrupted.

The patient when questioned was unable to remember that he had swallowed a piece of bone, but as he used alcohol to excess, it seemed likely that the accident occurred during one of his frequent debauches, from one of which he was recovering at the time of his admission to the hospital.

Dr. George G. Ross reported a case seen by him which was diagnosed as acute appendicitis; there was tenderness rather higher up than usual. At operation he found the appendix inflamed, but also noticed that on the outer wall of the cæcum there was a great deal more inflammatory lymph than on the inner. In pulling up the cæcum a tooth pick floated up into the wound and was removed. It seemed as if the tooth pick had gone through the ileocæcal valve and had pinned itself on the opposite wall of the cæcum and had ulcerated through.

Dr. Edward B. Hodge said that he saw a patient last summer which resembled Dr. Speese's case very closely: A boy of four years came to the Children's Hospital. It was thought that he had appendicitis; he had the usual symptoms and had had two attacks previously of colicky pain which had been diagnosed as appendicitis by the family physician. Operation revealed some adhesions in the right iliac fossa and some free dirty fluid; no pus. Appendix looked all right. Further search detected a stricture of the ileum about one foot from the ileocæcal valve and a perforation above through which a piece of pickle was protruding. He did not think the pickle made the puncture but the boy had perforation and a very tight stricture. A resection was done and the patient eventually got well.

Dr. Morris Booth Miller raised the question of perforation from foreign bodies. This matter has never been definitely worked out, *i.e.,* why certain objects cause perforation and others do not. All are familiar with the fact that children often have passed through their intestinal tract extraordinary substances, such as coins, pins, buttons and various materials of similar type. The great majority of these pass through without disturbance, but occasionally serious trauma is inflicted.

Twice he had seen perforation caused by a piece of bone. Several years ago he operated upon a woman who had all the symptoms of acute appendicitis. When opened it was found that she had a perforation of the appendiceal tip due to a piece of chicken bone, which was hardly larger than one-half the size of an ordinary pin. Again, about a year ago he had an experience with a woman, age fifty-five, who had previously undergone a hysterectomy. Following this she had had an incisional hernia which was characterized by adhesions. She was suddenly taken ill with pain, local tenderness in the hernial sac and vomiting. At operation an irreducible hernia was found but not obstruction. Within the sac a piece of chicken bone over an inch long had perforated the gut with some local contamination. It was hoped she would get well, but as she was diabetic she died from coma in two or three days. There was no generalized peritonitis.

(1) PERFORATED MECKEL'S DIVERTICULUM, (2) TWO INDEPENDENT SACS IN AN INGUINAL HERNIA, (3) REMOVAL OF PARAFFINE FROM INGUINAL CANAL IN CASE OF INGUINAL HERNIA.

Dr. A. Bruce Gill reported the following cases from the service of Dr. Hodge at the Presbyterian Hospital:

Case I.—A school-boy, aged thirteen years, admitted to the ward on the evening of March 4, 1913. For a week previous he had been having crampy pains about the umbilicus that occurred for the most part during the afternoon while the patient was in school. On the day of his admission about two o'clock in the afternoon while in school, he was seized with a sudden severe pain about the umbilicus and in the lower right part of the abdomen. He vomited repeatedly and was carried home from school.

On examination at ten o'clock p.m. there was present general abdominal rigidity which was most marked in the lower right quadrant. Pain and tenderness were chiefly in the same quadrant. The patient lay on his left side with the knees drawn up. On preparing the abdomen for operation a small red papule at the umbilicus bled slightly on being scrubbed.

The mother stated later that he had bled from the umbilicus in infancy, and the patient himself had observed a red spot at the umbilicus that would bleed on irritation.

Operation was performed at 10.25 P.M. The abdomen was filled with bloody serum. The appendix was long and kinked, but not diseased. A Meckel's diverticulum was found coming from the ileum about two inches from the ileo-cæcal junction. It was about two inches long and as large as the middle finger. A cord three inches long extended from the end of the diverticulum to the umbilicus. The diverticulum was highly congested and was thickened. Near its base was an annular thickening and constriction. On the distal edge of the dense ring was a small perforation filled with a blood clot.

With the exception of enlarged glands in the transverse mesocolon there was no other evidence of abdominal disease.

The cord attached to the diverticulum was ligated and divided near the umbilicus. The diverticulum was excised and its stump was inverted by a purse-string suture reinforced by Lembert's sutures. The appendix was removed. The abdomen was freely flushed with hot salt solution and a drain was placed in the pelvis.

Recovery was uninterrupted and the patient was discharged on March 21, 1913.

CASE II.—Man, aged fifty-five years. Four years ago he suddenly developed a right inguinal hernia. He was stacking soap-boxes weighing 100 pounds each. While he had the seventh box above his head and was about to place it upon the pile, his right foot trod upon a potato and he slipped suddenly backward. The patient immediately felt a sharp nauseating pain in his right groin, and shortly afterward he noticed a soft swelling in the same region. The hernia has slowly increased in size to the present time. He has latterly worn a truss that did not restrain the hernia but did cause considerable pain. The hernia was reducible.

At operation a hernial opening large enough to admit the forefinger was found internal to the cord and one inch above the external ring. Protruding about two inches through the opening was a pouch of transversalis fascia which contained preperitoneal fat and a thin empty peritoneal sac. The sac was drawn down, ligated, and excised, and its stump was transposed upward and inward and fastened behind the rectus muscle. Upon examination of the cord a second hernial sac was found coming out of the internal ring. It was freed from adherent veins, opened, and found to be empty. The sac was excised and the stump disappeared into the abdomen. The operation was completed according to the Bassini method, but with the addition of one suture that fastened the edge of the rectus fascia to Poupart's ligament near the pubic spine, and a second suture external to the internal ring.

Recovery was uneventful. The patient was seen recently, which is more than a year since the operation. There has been no recurrence of the hernia, although he returned to his former work and has been doing heavy lifting.

Case III.—Man, aged forty-eight years. He developed a right inguinal hernia seven years ago. Four years ago paraffine was injected at the side of the hernia by some person unknown. For eight months following this the hernia seemed cured, but at the end of that time it recurred and gradually increased in size. Several masses of paraffine could be felt beneath the skin and within the inguinal canal.

At operation one mass of paraffine was found imbedded in the aponeurosis of the external oblique in front of the canal, another lay beneath the skin above the canal, several pieces, including the largest, were within the canal. The vas was firmly adherent to three separate masses of paraffine and was dissected free with difficulty. The aponeurosis in front of the canal was dense and thick, and structures were obscured by the fibrous tissue about the masses of paraffine. The canal was exposed by splitting the external oblique above the canal and not in front of it and dissecting the lower flap downward. The largest piece of paraffine was near the internal ring, and its fibrous capsule was continuous with a mass of dense tissue that appeared to be an old obliterated sac. All the pieces of paraffine were removed.

A thin, wide-mouthed, empty sac was found posterior and internal to the cord and to the old obliterated sac. It was excised and its stump was transplanted upward and inward and fixed behind the rectus. The conjoined tendon and the edge of the rectus were sutured to Poupart's ligament in front of the cord. The upper flap of the aponeurosis of the external oblique was also sutured to Poupart's ligament, and the lower flap overlapped it and was sutured above.

Dr. Astley P. C. Ashhurst said that Dr. Gill's case of two sacs in an inguinal hernia reminded him of a similar sac found this winter while operating on a cadaver in the University. There were two sacs in the canal and extending down beyond the external ring; each had a separate opening into the peritoneal cavity at the internal ring. They were excised and sent to Dr. C. Y. White at the Episcopal Hospital for examination. He reported that both sacs were lined with endothelium apparently indentical. The existence of adventitious bursæ which are not very rare in the wall of a hernial sac is easily explained, but he knew of no satisfactory explanation for two distinct sacs, unless both are congenital.

As regards Meckel's diverticulum, he had seen three cases. The first case was reported to the Academy some years ago. There was an internal hernia through a rent in the mesentery of the ileum. The patient was a child, aged twelve, and, as he had learned that if in children from thirteen to fifteen years of age, the umbilicus appears abnormal, one should suspect the existence of a Meckel's diverticulum, the opinion was hazarded before operation that this might be the origin of the obstruction.

Only a month later he saw a man of forty-six years with symptoms of intestinal obstruction. He also had an abnormal umbilicus; four spots could be seen where the fetal structures had come through. In this case the diverticulum was found adherent to the umbilicus on the inside and twisted on itself. Unfortunately, the man died, in spite of relief of the obstruction.

Another case of Meckel's diverticulum he saw in a patient with typhoid perforation. The perforation occurred in the ileum and in looking for more perforations he found a slightly inflamed but non-adherent diverticulum higher up. This patient, who was eighteen years of age, had an abnormal umbilicus.

Dr. Addinell Hewson said that recently, in his service at the hospital, a case came in with symptoms suggesting acute obstruction. Operation was performed and it was found that a Meckel's diverticulum was present and located about 2 feet from the ileocæcal valve, was twisted around the intestine and caused complete obstruction. This case was not in a young person, but in a man of mature age who made an uneventful recovery.

SUTURE OF THE HEART.

Dr. Arthur E. Billings reported the case of a man, thirty-one years old, who was brought to the Pennsylvania Hospital, at 2.55 a.m. on May 7, 1911, and was admitted to the service of Dr. Hutchinson, to whom the reporter was greatly indebted for the privilege of operating upon and reporting this case.

The patient's previous history was negative except for marked alcoholism for the last two years. Present condition: While walking through the east side of Franklin Square he was attacked by a man who stabbed him and fled. He was found by a policeman lying in an alley between Fifth and Sixth and between Race and Vine Streets, from where he was brought to the Pennsylvania Hospital by the patrol wagon. He was unconscious at the time of his admission, presenting the picture of extreme shock with hemorrhage. Temperature was 95°, breathing labored and sighing in character, radial pulse was imperceptible, and skin was clammy and cold. On examination of his thorax, there was a wound about 2 cm. in length in the midclavicular line of the left fifth interspace which was bleeding quite freely with respiratory movements. Percussion and auscultation revealed signs of a marked hæmopneumothorax. The heart sounds were irregular and distant, rapid, and at times almost inaudible.

Operation.—Local preparation consisted of shaving and the application of tincture of iodine to the field of operation. A semilunar incision was made over the left fourth and fifth ribs with the convexity toward the sternum. The fourth and fifth ribs were then severed near the costal border and turned outward about 5 cm. away from the sternal border forming a trap door. The left pleural cavity was filled with blood and the pericardium showed a wound about 1.5 cm. in length and was distended with blood. This opening was increased in length exposing the heart which revealed a wound in the left ventricle between 2 and 3 cm. in length on the external surface and slightly triangular in character, which was bleeding profusely with each systole, and was partially controlled by digital pressure during suturing.

This was closed with five interrupted sutures of No. 1 iodized catgut. The pericardium was closed with a continuous No. 1

iodized catgut suture, without drainage. In the lower lobe of the left lung on its anterior surface, there was a ragged wound about 4 cm. in length which continued to bleed slowly and persistently. The sixth rib was then resected in the left midaxillary line and a small gauze pack was introduced to control bleeding from the lung. The trap door was then closed, the ribs being sutured in place with No. 5 iodized catgut and the skin closed with interrupted silkworm gut sutures without drainage. During the first part of the operation, an anæsthetic was not necessary, ether being used during the latter part of it. During the operation the patient received twenty-four ounces of normal salt solution, intravenously, and strychnine sulph., grains 1/20 hypodermically. After the operation the reaction was fairly prompt and surprisingly good. Pulse one hour after operation was 88 and temperature 96.2°.

During the following twelve hours, temperature reached 102.2°, soon dropping to normal with pulse ranging from 88 to 120, and the patient rational. Thirty-six hours after operation, patient's temperature began to go up, reaching 101.1°, pulse 120 to 140, with much respiratory distress and increasing cough with gradual circulatory failure, death resulting about forty-eight hours after operation. Cardiac compression is suggested in this case because of the marked increase in bleeding after opening the pericardium and improvement in patient's condition at this time.

Autopsy revealed extensive pleurisy and complete solidification of the already collapsed left lung with slight pericarditis about the line of incision and wound.

SPLENIC ANÆMIA WITH SPECIAL REFERENCE TO ETIOLOGY AND SURGICAL TREATMENT.

Dr. J. Stewart Rodman and Dr. De Forest Willard read a paper with the above title for which see page 601.

Dr. Astley P. C. Ashhurst said that the incision in the abdominal wall described by Dr. Willard is very similar to that on the right side which has been employed for many years by Czerny for operations on the gall-bladder and bile-ducts. It has now been adopted by Kocher as his " normal incision " for difficult cases. The extension of the incision outward beyond the semilunar line corresponds to the incision of Kausch and certainly presents many advantages. He had one occasion himself, four years ago, to explore the cardiac orifice of the stomach and the spleen in a case of gunshot wound. The injury involved both the thorax and obdomen. He made first an incision in the line of the eighth left intercostal space, splitting the abdominal wall in a direction parallel to the nerves. Then the diaphragm was incised sufficiently to expose freely, after retraction of the eighth rib upward and the ninth rib downward, the region above the fundus of the stomach, including the spleen, the left lobe of the liver and the pancreas. Later the lung was exposed. He secured ample exposure by this incision, the abdominal portion of which corresponds to Kausch's, and to the horizontal limb of the incision advocated by Dr. Rodman and Dr. Willard; but unfortunately the patient did not recover.

Dr. George P. Müller reported the following case which he believed to be one of splenic anæmia. The history is as follows: A man, aged thirty, was awakened on the morning of August 26, 1912, by a feeling of nausea without pain. He then vomited a pint of blood and some hours later vomited again a lesser amount. Between the two vomitings he was treated by rest, ice, morphine and calcium lactate. He was sent to the University Hospital by his physician, Dr. Janvier, at about 7 P.M. The patient was a healthy baby until about two years of age, when he had some vague stomach or bowel trouble, accompanied by considerable pain and diarrhœa. This lasted for 3 or 4 weeks and he then recovered quite completely. During boyhood and up to the age of 18 years of age he was apparently well, although always of slim build and having a very white skin. Shortly after this time he had an attack of severe abdominal cramps with profuse diarrhœa after eating freely of oysters, ice cream and peaches. A few days later he had a similar attack and from this time on he has never been entirely well or free from pain and abdominal discomfort. The slightest indiscretion in diet brings on an acute attack of indigestion with abdominal pain and diarrhœa. About a year ago he had a severe attack of abdominal pain and diarrhœa associated with bladder trouble, jaundice, high fever and chills. He was in bed a week or ten days and became reduced in weight and strength. Has had no attack since then but has frequently had sick headaches occasionally associated with vomiting and also with pain in lower abdomen and with diarrhœa. After the attack 4 or 5 years ago he had a small hemorrhage from the bowel, but the diagnosis at that time was never definitely made, the condition being counted as a chronic enteritis. Patient is well built, rather fat, active mentally, and occupying a good clerical position. Upon examination shortly after admission the abdomen was flat without rigidity, masses or tenderness. The liver was not enlarged but the spleen seemed slightly so and was palpable one inch below the costal margin. Blood count made at the time revealed: Hæmoglobin, 67 per cent.; red blood corpuscles, 3,730,000, and a leucocytosis of 12,700, of which 81 per cent. were polynuclear. After his admission to the hospital he continued the line of treatment which Dr. Janvier had begun and in addition gave 20 c.c. of horse serum. At 10 P.M. he vomited 16 oz. of blood and, accordingly, it was thought that his stomach should be explored. Incision in right rectus close to the median line and extending from the ensiform to the umbilicus. Upon opening the abdomen the pale intestines and stomach presented nothing noteworthy and upon exposing and drawing the stomach into the wound, no evidence of ulcer could be detected, there being no points of thickening, scars, adhesions, no milk-white patches. The lymph nodes in the greater and lesser curvature were not enlarged. The liver was normal in appearance with thin, sharp edges. The gall-bladder was slightly distended but not abnormal. The spleen was large, measuring about 8 by 5 inches in size, quite firm to the touch and smooth. It was closely approximated to the fundus of the stomach. A small vertical incision was made in the stomach and considerable blood, both fluid and clots, evacuated. A small proctoscope was introduced and the stomach searched from one end to the other for ulcers, erosions or other evidence to show the origin of the hemorrhage. Absolutely nothing was found. In places the mucous membrane appeared congested but nowhere was there evidence of active bleeding. The wound in the stomach was closed with catgut and linen and the abdominal one with catgut and silkworm gut. Patient stood the operation fairly well, but was given 750 c.c. of normal saline solution intravenously at the close of operation.

Patient recovered fairly well from operation without much shock. Temperature gradually declined and reached normal on the sixth day after operation. Thirty-six hours after operation a blood count revealed hæmoglobin, 40 per cent., and red blood corpuscles, 2,910,000. The fat in the wound showed signs of infection and four or five of the stitches were removed and several ounces of pus evacuated, after which the condition of the wound remained uneventful. At the end of the first week the patient began to pass considerable dark, foul-smelling material from the bowels, the passage of which was controlled by the administration of opium and resorcin. On September 3, seven days after operation, the blood count revealed a hæmoglobin of 24 and red blood corpuscles of 4,470,000. It was evident that the black material coming from the bowel was due to intestinal bleeding and was not a residual of the stomach hemorrhage. More horse serum and certain other drugs were given, after a consultation with Drs. Stengel and Klaer, but made no impression on the patient who became delirious and died on September 9, thirteen days after the operation. No autopsy was allowed but the reporter had always believed this patient was suffering from splenic anæmia, caused by some intestinal toxæmia.

He was especially anxious to report this case because of the error in diagnosis which was made, that it was a case of hæmatemesis from gastric ulcer, based on the history of gastric distress followed by the vomiting of blood. At the time of operation a full history was not obtained but the diagnosis seemed clearly evident, especially in view of the fact that the the patient was practically a total abstainer from alcohol and there was no evidence of syphilis or other disease of the liver. It was the intention to perform a splenectomy when the patient's condition permitted and the family were so informed at the close of operation, but the occasion never arose.

105 CASES OF STRANGULATED HERNIA.

Dr. Emory G. Alexander read a paper with the above title, for which see page 639.

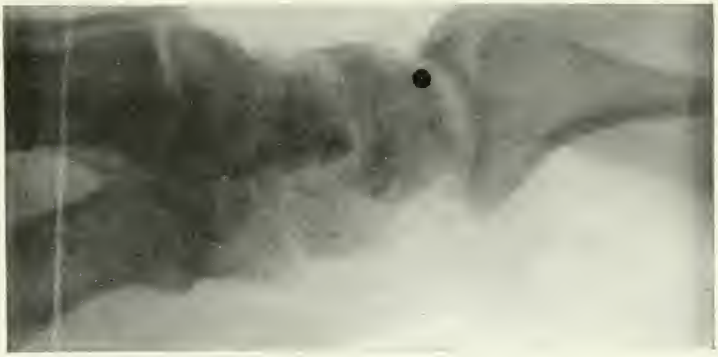
FRACTURE OF CARPAL SCAPHOID AND CUNEIFORM WITH LUXATION OF SEMILUNAR; BLOODLESS REDUCTION; FUNCTIONAL RECOVERY.

Dr. P. G. Skillern, Jr., reported the history of a man, aged twenty-seven, who fell upon his hyperextended left hand. Ex-

Fig. 1.

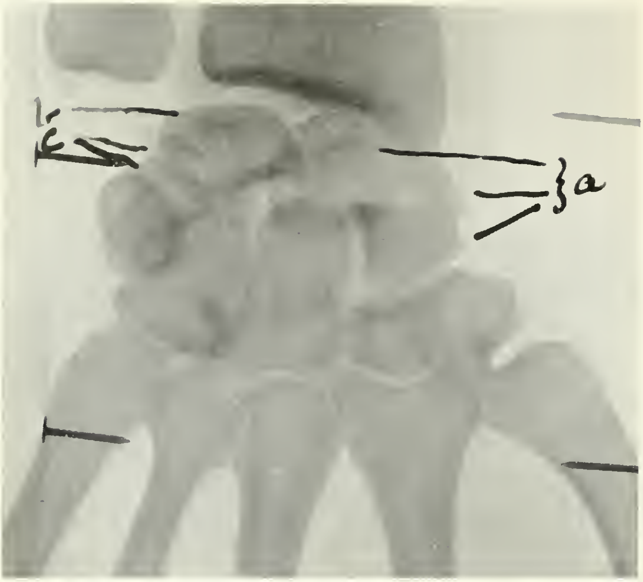
Lateral view before reduction. Note displacement of semilunar anteriorly beneath os magnum; also, shortening of carpus by approximation of metacarpus to radius and ulna.

Fig. 2.



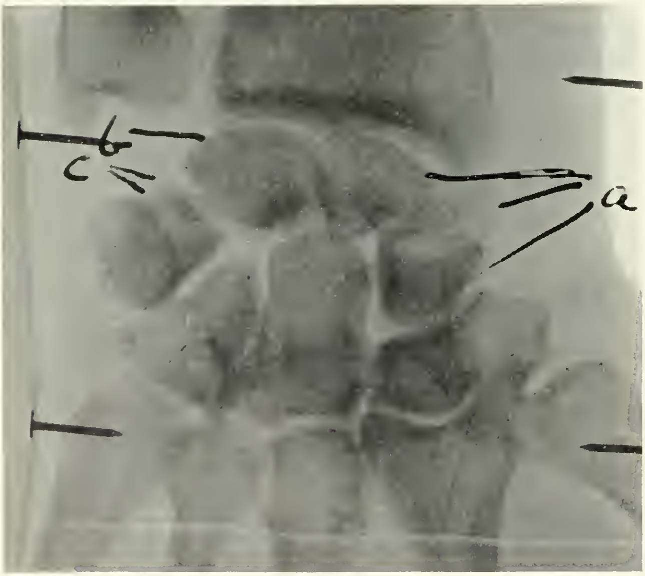
Lateral view after reduction. Note restoration of scaphoid to its normal position with consequent lengthening of carpus.

FIG. 3.



Anteroposterior view before reduction. Note *a*, tripartite fragmentation of scaphoid; *b*, displacement of semilunar; and *c*, fracture of cuneiform.

FIG. 4.



Anteroposterior view after reduction. Note *a*, improvement in position of scaphoid fragments; *b*, restoration of semilunar, and *c*, of fragment of cuneiform.

amination shows swelling around wrist-joint with tenderness in snuff-box and in front of carpus, and also a bony prominence in wrist beneath flexor tendons with shortening from tip of radial styloid to base of first metacarpal. Diagnosis of fracture of scaphoid with luxation of semilunar. Skiagram (Fig. 3) shows separation and displacement of scaphoid tuberosity between tip of radial styloid and trapezium; luxation of semilunar, and fracture of cuneiform. Lateral view (Fig. 1) shows displacement of semilunar into palm with rotation about its transverse axis, so that its concavity faces dorsally, and also a hollow on dorsum between posterior articular edge of radius and os magnum. The patient was immediately anæsthetized with nitrous oxid and manual reduction effected by the method described by Codman and Chase (ANNALS OF SURGERY, 1905, xli, 321, 863). Dressed on Bond splint. Skiagram (Fig. 2) now showed complete reduction of semilunar and (Fig. 4) improvement in position of fragments of scaphoid and cuneiform. After reduction the patient complained no longer of pain. Immobilization was maintained four weeks *without massage and without passive motion.* It must be remembered that this bone is but feebly capable of osteogenesis and is constantly bathed by the synovial fluid, the amount of which would only be increased by massage and passive motion, thus adding fuel to the fire. There being union at the end of four weeks, careful massage and passive motion rapidly restored complete function to the wrist-joint.

A similar case has been described by Corner (*Trans. Clin. Soc.*, London, 1905, xxxviii, p. 224) but the semilunar was fractured, in addition to being luxated, and the cuneiform showed fracture of the portion nearest the radius which damage, as Corner states, was obviously done by the lower end of the radius being forcibly driven on to the carpus. This was shown by close proximity of ulna to cuneiform. This injury was of eighteen month's duration, and had not been reduced. The patient complained that his hand was weak and occasionally painful, and that it had lost some of its power of movement.

The results of neglect or of improper management of this injury is further illustrated by an old case of undiagnosed and therefore unreduced fracture of scaphoid with luxation of semilunar recently described by the author (*Jour. A. M. A.*, 1913, lx, p. 1536). This patient had injured his right wrist seven months previously in a street accident, and had been treated in another hospital for two weeks as a "bad sprain," skiagram taken at the time being declared negative. Since then the wrist was crippled, flexion and extension being very limited, and patient had pain in the joint on the slightest motion. Owing to the long lapse of time (seven months) since the injury, but one method of treatment was indicated, removal of the semilunar with both fragments of scaphoid. This was done, with relief of pain and increase of motion.

Fracture of the scaphoid with or without luxation of the semilunar is not a rare injury, and readily lends itself to clinical diagnosis by localized "wincing" tenderness in the snuff-box with, in case the semilunar be luxated, a distinct bony prominence in front of the carpus beneath the flexor tendons. This injury should be suspected with the same facility with which Colles' fracture is suspected and the same careful anatomical reduction should be made in order to avoid crippling of the wrist of a wage-earner and subsequent liability for damages which in such an instance seems glaringly justifiable.

CORRESPONDENCE.

LATER HISTORY OF CASE IN WHICH TEN FEET EIGHT INCHES OF GUT WERE REMOVED.

Editor Annals of Surgery:

In the November issue of the Annals of Surgery, 1911, there appeared the history of a case which had been curetted by another physician for a macerated fœtus; the uterus was perforated and the patient's gut torn from the mesentery necessitating the removal of ten feet eight inches of the ileum. This was July 10, 1911. In December of the same year she developed a peritonitis of obscure origin vaguely pointing to right tubo-ovarian inflammation with possible appendiceal involvement. She was treated expectantly for six days when an abscess pointed in the cul-de-sac. At this time she was exceedingly septic, having chills, sweats, typical "pump-handle" temperature (maximum 104.5° F.), a thready, intermittent pulse, 120–160. Under nitrous oxid her uterus was curetted and several pieces of fetal bone found; very fetid odor. The pelvic mass was drained through the vagina; she was placed upon Murphy treatment. Drainage was good for five days, though the pulse never dropped under 120°, when it was noticed that the abdominal scar was bulging. This was incised and a large amount of pus evacuated. Her symptoms gradually subsided and she was discharged in three weeks.

Patient remained well and gained several pounds in weight, but unfortunately contracted a double pneumonia in April, 1912, in which resolution was delayed until the 28th day, leading us to suspect a tuberculosis. Under forced feeding she regained the lost ground.

In May, 1913, she began having vague pains in the abdomen (especially on the right side) which progressively grew more severe. Gastric disturbances made their appearance; she ran a rapid pulse with slight elevation of temperature; had a profuse vaginal discharge. After absolute rest, use of ice-caps, restricted diet (the process apparently not being controlled), a supravaginal hysterectomy and appendectomy was done at the Woman's College

Hospital, June 17, 1913. A double pyosalpinx, chronic appendicitis and extensive adhesions were found. No drainage used. Patient left the hospital on the eighteenth day and at the present writing (September 27, 1913) she has returned to her work.

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Philadelphia, Pa.

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ORIGINAL MEMOIRS

STUDIES IN BLOOD PRESSURE BEFORE, DURING, AND AFTER OPERATIONS WITH REFERENCE TO THE EARLY RECOGNITION, PREVENTION AND TREATMENT OF SHOCK.*

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THE evidence available at the present time, while by no means sufficient to prove, is yet enough to indicate that we have made great advance in the early recognition, prevention and treatment of shock due to operative interference.

There are two factors in shock over which we have the greatest control—the toxic factor due to the anæsthesia, and the traumatic factor due to the operative manipulations. Our knowledge of these factors has been gained from experimental investigations on animals and careful clinical observations.

In the beginning of anæsthesia, chloroform was the anæsthetic of choice. It seemed to have advantages over ether—it was more easily administered, the patient became narcotized with less struggling, was more relaxed during the operation, and the post-operative discomforts were less. But it was soon found that chloroform has distinct dangers—it is more toxic than ether; during its administration the blood pressure falls more rapidly; sudden deaths occur during its administration and are not infrequent at intervals after an apparently complete recovery from the anæsthesia. These late deaths are due to certain cell changes caused by the toxic action of chloroform. The longer a patient is kept completely narcotized by chloroform, the greater the immediate and later dangerous effects.

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* Read before the American Gynecological Association, Washington, D. C., May, 1913.

These observations gradually led to the substitution of ether for chloroform as the anæsthetic of choice. It must have been these dangers that were the paramount factors in the change, because ether is more difficult to administer, the time required to get the patient completely narcotized is longer; distressing complications, such as cyanosis and locking of the jaws during the administration, are more frequent; the after-effects of ether are more disagreeable than of chloroform; ether is more expensive than chloroform. In spite of these apparent disadvantages, ether won out, because careful observations demonstrated that it had real advantages on the side of safety. The administration of ether attained its highest perfection in the so-called drop method on an open cone.

Surgeons, however, were not satisfied and sought for other methods of anæsthesia which would eliminate even the discomforts and dangers of the perfected method. The dissatisfaction led to various forms of local, spinal, intravenous and rectal anæsthesia.

Convinced that the chief danger of ether was due to its toxicity and finding that many operations were impossible under local anæsthesia alone, surgeons continued their search for a general anæsthetic whose action would be less toxic, or not toxic at all.

Apparently nitrous oxid and oxygen up to the present time is the general anæsthetic with the least toxic effect. As a matter of fact we have no proof that it has any toxic action.

At first the nitrous oxid was employed without the oxygen, as an introductory to ether, simply to shorten the period of the anæsthetic time. It was soon found that it had no advantage in reducing the amount of ether administered. Then attempts were made to perform longer operations under nitrous oxid alone, and these finally led to the combination of the gas with oxygen which permitted a longer anæsthesia with less cyanosis.

The combination of local anæsthesia with general, such as chloroform or ether, has long been employed. The object, however, of this combination was to reduce the amount of the general anæsthetic to a minimum. Those who employed it did not have in mind that the local infiltration was also of advantage in reducing traumatic shock due to local injury during the operative manipulations.

Operators, of course, have been familiar for a number of years with the fact that there is a definite factor in shock due to the cutting, tearing and handling of tissues during operations, but they seem to have devoted less attention to the reduction and elimination of this factor than to the toxic factor of the anæsthetic. They have been too prone to blame the anæsthetic for their operative and post-operative shock, its mortality and complications, rather than to place some of the odium on their own manipulations.

When I came to Dr. Halsted's clinic at the Johns Hopkins Hospital, in 1892, I found that he had very definite ideas of his own in regard to shock, different from those who had been my teachers in surgery and from the ideas I had gained from reading up to that time. He perhaps emphasized most the factor of hemorrhage, and his operations were more bloodless than any I had witnessed until then. He was also of the opinion that tissues should be handled gently—cut, not torn; that in clamping, the bleeding point only should be caught and not large masses of tissues crushed; that large wounds should be made, because through these the necessary manipulations could be more gentle. He evidently had in mind by these manipulations not only to reduce shock due to trauma, but the better healing of a wound in which the tissues were less injured. He also endeavored to operate with the least amount of ether possible. Dr. Halsted was among the first, perhaps the first, to practise local anæsthesia, because it was safer.

When I began to investigate surgical shock and to critically review the literature (*Progressive Medicine,* December, 1899, p. 155) I read and reviewed the experimental work on surgical shock by George W. Crile (J. B. Lippincott Co., Philadelphia, 1898)—an essay awarded the Cartwright prize in 1897.

It is my opinion that we owe to Crile more than to any other writer our knowledge of the factors which produce shock, and of the early recognition, prevention and treatment of this definite surgical complication. In the sixteen years since his first publication Crile has continued his experimental investigations and has added to them great clinical experience. This has resulted in the development of a definite technic—a combination of local and general anæsthesia.

The paramount object of this new technic is to reduce the toxic action of the general anæsthetic and the traumatic factor of the operative manipulations to a minimum. The technic consists of general anæsthesia by nitrous oxid and oxygen, with little or no ether, and infiltration of all tissues divided or handled with 1 : 400 novocain.

This technic makes the operative time longer, puts more labor on the surgeon, requires infinite patience.

I am confident that it will never become popular until it is clearly demonstrated that it does reduce shock and operative mortality, post-operative discomforts and complications, and shortens the period of disability due to the operation.

For more than three years I have attempted to employ this method in every operation. In the majority of cases I have a complete record of the pulse and blood pressure before, during, and after the operation, with notes on the behavior of the patient in relation to the operative manipulations.

Fig. 1 represents the anæsthetic chart now employed. In the central column the pulse and blood pressure are recorded every five or ten minutes; the respirations are also recorded in their proper place. In the column to the right the one in charge of the anæsthetic chart notes from the dictation of the surgeon the various manipulations, for example: skin incision, peritoneum opened, mesentery pulled on, division of stomach, etc. In the left-hand column there is noted from dictation by the anæsthetist or by the surgeon the condition of the patient and any change in the method of administration of the anæsthetic, for example: gas started, infiltration with novocain; patient quiet; color good; patient cyanotic, moves, struggles; vomits; gas off; 20 drops of ether given; morphine hypodermically gr. 1/10; subcutaneous infusion of salt; strophanthin intravenously, etc.

Thus we obtain a graphic record of the effect of the definite operative manipulations on the pulse, blood pressure, respirations and condition and conduct of the patient during the operation.

These will be discussed more in detail.

From my observations I am convinced that any operation performed under this method of anæsthesia, properly carried out, will result in less shock; the mortality will be lower; the post-operative discomforts and complications will be greatly reduced, the period of disability very much shortened. All this has certainly been accomplished in my own experience, and I think I have convinced my associates, both surgeons and nurses, that this method has great advantages over ether. I am also confident that no operating surgeon will come to the same conclusions until he has faithfully given this method a fair trial over a considerable period of time.

It is important, in the first place, to emphasize here that success depends perhaps most on your technic of local infiltration. No surgeon, who has not performed many operations under local anæsthesia only, will be able to get the same results from the combined method. When the patient is awake and you attempt an operation under local anæsthesia, you will always be informed when a painful act takes place, and you will be surprised at the difficulty of making such an operation perfectly painless. Very few surgeons in this country have educated themselves in the difficult technic of local infiltration. They are not familiar with the sensitiveness of the different tissues and the varying degrees of discomfort following different manipulations. It is my opinion that the first step in the development of this new technic is to perform as many operations as possible under local anæsthesia.

Under nitrous-oxid-and-oxygen general anæsthesia the patient as a rule moves when any very painful step is performed, but there is no such reaction to the less painful manipulations, so that if you begin with general and local anæsthesia, you will be aware only of the more severe traumas and you will by no means block all painful afferent sensations. And, as the patient only moves and does not cry out, the surgeon will naturally be less influenced. The mere introduction of 1 : 400 novocain here and there will by no means accomplish the result.

When the patient is anæsthetized with ether or chloroform, he does not move when painful manipulations are made, and many surgeons are of the belief that such painful stimuli do not produce the same effect upon the nerve cell as when the patient is awake. A careful study of the blood-pressure records during operation and post-operative convalescence will dispel this belief. General anæsthesia apparently obliterates only the psychic shock which would ensue if the patient were awake. We have no proof that traumatic shock from painful wound insults is reduced by general anæsthesia, and the evidence is rather in favor of the contrary.

Theoretically the entire field of operation should be so blocked by local anæsthesia that the brain cells receive no sensory impulses. This is not possible in all operations, and for this reason a general anæsthetic becomes necessary. If one could completely block these impulses, and eliminate the fear of the patient, a general anæsthetic would be superfluous. The endeavor of the surgeon, therefore, should be to reduce the sensory impulses from the wound to a minimum.

The difficulty of proving that the combined method of anæsthesia lowers mortality, reduces post-operative complications and discomforts and shortens the period of disability, is due to the fact that, in the first place, the records of many clinics are not sufficiently accurate and complete to allow a statistical study. In the second place, the mortality and other complications are relatively small for the majority of operations upon the average patient.

Even with rather bad ether narcosis and rough operative manipulations the mortality and other complications are not large when studied in the aggregate. With ether narcosis by the perfected method in the hands of an expert, and when the operation is performed by a skilled surgeon rapidly and without local anæsthesia, we have reason to believe that the mortality and complications are reduced.

The majority of surgeons apparently agree that, given the same operative skill and experience, the chances are better with ether as an anæsthetic than with chloroform, and still better when the ether is given by the perfected drop method and by an expert.

We must, therefore, compare this method of combined local and general anæsthesia with our results under the perfected ether method by a skilled anæsthetist, but without local anæsthesia.

For the ordinary operation upon the healthy individual the difference in mortality will be slight, but I am confident that a great difference will be found in the post-operative complications and discomforts and in the period of post-operative disability. The difference in the mortality from shock after grave operations upon healthy and upon handicapped individuals becomes very striking when these groups are studied separately. I am certain from my experience that the combined method of anæsthesia will reduce this mortality.

The mortality of simple and ordinary operations upon patients whose resistance before operation has been lowered by various factors, is by no means insignificant, and here I am also sure that the more difficult method of the combined anæsthesia will lower the mortality.

No statistics are available in the literature as to these facts. The investigation must at first be chiefly a personal one. Each surgeon must familiarize himself with his own results in the different groups of cases and then see whether there is improvement when the operations are performed under a combination of nitrous-oxid-and-oxygen general anæsthesia and local infiltration with 1 : 400 novocain.

This brings me to the most important point in my discussion. In order to perfect this method of combined anæsthesia, it must be employed in every case, and then, after a large number of observations have accumulated, the surgeon will be in position to compare the results.

Every patient must be looked upon as handicapped and extremely ill. Every operation must be considered a grave one. Every detail of technic should be carried out conscientiously.

Surgeons will find that this requires time. The surgeon will either have to work more hours in the day, or perform fewer operations.

In my own experience I have observed, first, a most distinct improvement in the post-operative convalescence. Pneumonia, thrombosis and phlebitis, gas pains and distention of the abdomen, acute dilatation of the stomach, anuria and nephritis have become distinctly less frequent. Now, as a matter of fact, the graver of these complications were not very frequent after good ether anæsthesia. It is only when one studies the smaller group of handicapped individuals and the graver operations, that the difference becomes more evident.

The lessening of the ordinary post-operative discomforts which cannot be looked upon as grave complications is the most evident feature of the method of anæsthesia here advocated.

The proof that the mortality is lessened after operations under the combined form of anæsthesia is most difficult to furnish. I am quite confident that resection of the colon and stomach for ptosis and its complications will prove much less dangerous when performed under the combined method of anæsthesia and that the results as regards post-operative mortality will improve very considerably. A study of fifty such cases of my own observation is in course of preparation and presents the available proof of my contention.

The various factors which enter into the question of estimating how to reduce mortality, post-operative complications and discomforts, and shorten the period of disability, are so numerous and each one so important, that it will not be out of place to mention them here. The mere substitution of nitrous oxid and oxygen for ether and the routine employment of local infiltration are by no means sufficient to alone accomplish the results hoped for.

The patient must be properly prepared—mentally and physically—for the operation. I have discussed this in a paper entitled: Estimation of the Vital Resistance of Patients with Reference to Possible Recovery after Surgical Intervention (ANNALS OF SURGERY, May, 1912).

The period of time between the onset of the disease and the operative relief is an important factor—in some cases the essential factor, and if this is not considered in the study of post-operative mortality, our conclusions may be misleading. For example, very early operations for intestinal obstruction under ether narcosis without local anæsthesia would probably show less mortality than late operations for the same condition under the most perfect combined local and gas anæsthesia. But my own statistics show that when we consider the cases of intestinal obstruction operated upon late, we will find that the mortality after ether narcosis is distinctly greater than after local anæsthesia alone, or combined local and gas anæsthesia. But even in this group another factor must be considered—whether enterostomy was performed or not. If the operator, with his improved method of anæsthesia, failed to perform enterostomy, while another with bad ether anæsthesia did, the latter's results would probably be better.

These examples show the importance of considering all the factors of safety when we attempt to get at the methods which yield the best results.

The condition of the patient before operation depends upon many factors. As a rule the earlier the intervention, the better the results. I have attempted to show this in a previous communication (The Medical Aspects of Surgical Diseases, or Preventive Surgery, *Jour. of Amer. Med. Assc.*, March 23, 1912, lviii, p. 829).

In conclusion we may sum up the question with the statement which apparently cannot be controverted, that there is a mortality, an increase in the number and severity of post-operative complications and discomforts, and a lengthened period of disability due to operative shock. The factors are psychic, due to fear; toxic and traumatic, due to the condition before operation; and psychic, toxic and traumatic, due to the operation itself. These factors may continue after operation.

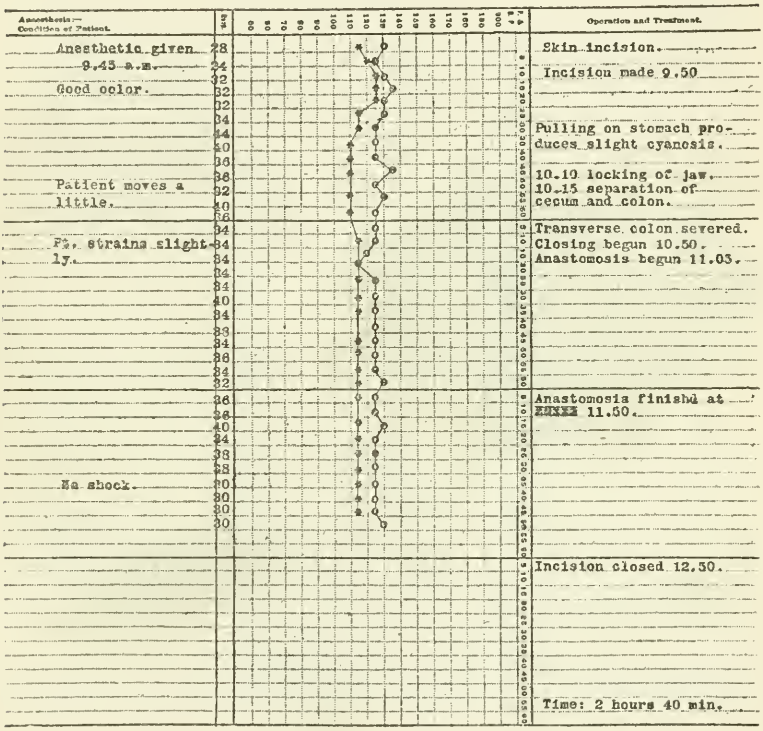
There is no question that we wish to improve our results, and to accomplish this, all factors must be borne in mind.

The absolute proof that the substitution of nitrous oxid and oxygen combined with local anæsthesia for ether alone, will rest at first upon a personal investigation by the individual surgeon. We have not yet reached the stage when comparisons with the results of different surgeons will be as helpful, because as yet it seems impossible to get at all the factors which enter into the problem.

To obtain the best results, every surgeon must attempt to improve all of his methods, to get his patients earlier, to study more carefully the preparation for operation, to improve his general and local anæsthesia, to improve his own technic, to study and make better his post-operative treatment. Then, and only then, will he observe and be able to estimate the factor of the toxic shock from ether and the traumatic shock due to operation without local infiltration.

Fig. 1 is a chart made during the resection of the right half of the colon. The anæsthetic was gas and oxygen combined with local infiltration of 1:400 novocain; the full time of the operation was two hours and forty minutes. You will notice practically no change in the pulse or blood pressure; the patient's color was good throughout the operation. You will note that during the separation of the cæcum and colon, when some tension was put on the mesocolon, the patient moved a little and there was slight locking of the jaws; the blood pressure rose slightly. When the transverse colon was divided with the Paquelin cautery, some slight tension was again placed on the mesocolon, and the patient reacted in a similar way. With these two exceptions the patient was absolutely quiet throughout the operation. Not a drop of ether was given. From the behavior of the blood pressure and the patient we can be quite confident that no very painful manipulations were carried out. This patient had a greatly dilated duodenum due to a ptotic cæcum pulling on the mesentery of the small intestine because of the shortness of the mesentery of the ileum near the cæcum. She had been an invalid for seven years; gastric symptoms with vomiting had been present one year. She had lost weight, was anæmic, very nervous; the kidney function, however, was unimpaired, and there was no evidence of a cardiac lesion. Here, therefore, we have a grave operation performed upon a somewhat handicapped patient. Her condition at the end of the operation

FIG. 1.



Anesthetic given 9.45 a.m.

Good color.

Patient moves a little.

Pt. strains slightly.

No shock.

Skin incision.

Incision made 9.50

Pulling on stomach produces slight cyanosis.

10.10 locking of jaw.

10.15 separation of cecum and colon.

Transverse colon severed.

Closing begun 10.50.

Anastomosis begun 11.03.

Anastomosis finishd at 11.50.

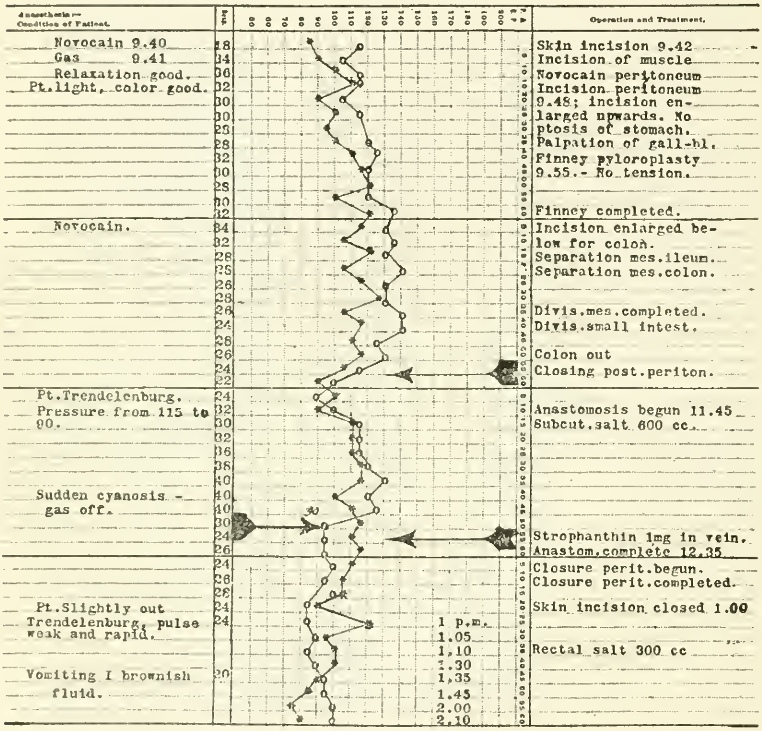
Incision closed 12.30.

Time: 2 hours 40 min.

was as good as after an ordinary thirty-five-minute appendectomy performed under ether narcosis. I have discussed this lesion—chronic gastromesenteric ileus—in the *American Journal of Gastro-Enterology,* July, 1912.

Fig. 2. In this case the patient also suffered from a chronic gastromesenteric ileus; in addition there was pyloric stenosis due to a healed ulcer, requiring a Finney pyloroplasty in addition to the resection of the right half of the colon. You will note that the operation required three hours and twenty minutes; no ether was given; the patient took the gas and oxygen well, and local infiltration with 1 : 400 novocain was employed throughout the operation. The general condition of this patient was not as good as in the previous case: she had been bed-ridden for nine months and had existed on practically only buttermilk. She was extremely emaciated, with quite marked secondary anæmia. The kidney function was good, and there was no cardiac lesion. You will note that during the Finney pyloroplasty, which was done with practically no tension, the pulse and blood pressure varied more than in the previous case

FIG. 2.



Novocain 9.40
Gas 9.41
Relaxation good.
Pt. light, color good.
Novocain.
Pt. Trendelenburg.
Pressure from 115 to 90.
Sudden cyanosis — gas off.
Pt. Slightly out Trendelenburg, pulse weak and rapid.
Vomiting I brownish fluid.

Skin incision 9.42
Incision of muscle
Novocain peritoneum
Incision peritoneum 9.48; incision enlarged upwards. No ptosis of stomach.
Palpation of gall-bl.
Finney pyloroplasty 9.55.- No tension.
Finney completed.
Incision enlarged below for colon.
Separation mes. ileum.
Separation mes. colon.
Divis. mes. completed.
Divis. small intest.
Colon out
Closing post. periton.
Anastomosis begun 11.45
Subcut. salt 600 cc.
Strophanthin 1mg in vein.
Anastom. complete 12.35
Closure perit. begun.
Closure perit. completed.
Skin incision closed 1.00
Rectal salt 300 cc

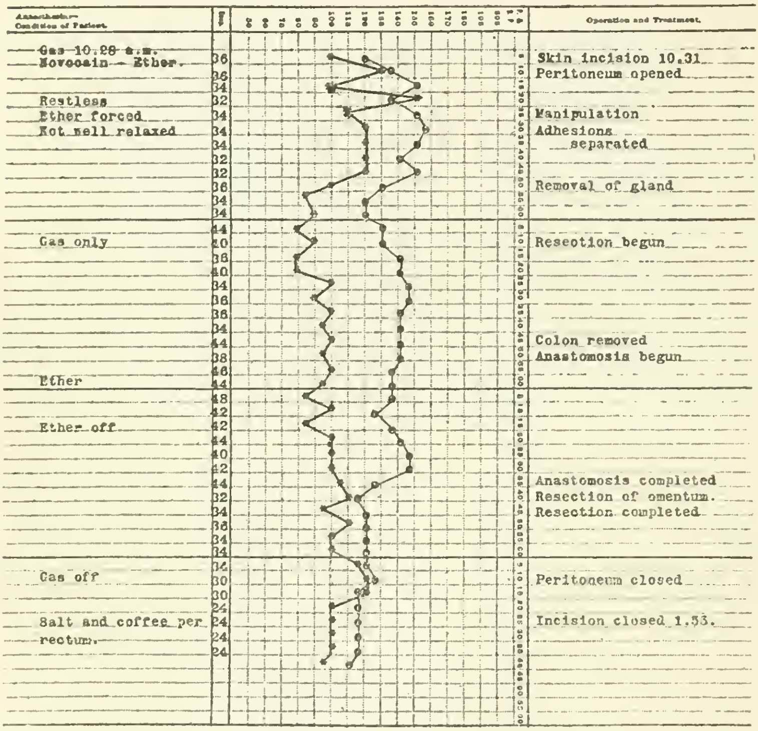
during the first hour. This was due probably to the palpation of the gall-bladder and investigation of the condition of the pancreas and duodenum. You will note that in the second hour, during the entire time while the colon was being resected, the pulse and blood pressure showed but slight variations. Even these slight variations, as compared with those in the previous case, indicated to the operator that he was dealing with a patient with but slight factors of resistance. This is shown on the chart at the position of the first arrow. In closing the rent left in the peritoneum after the removal of the colon, one has to handle most sensitive tissues in an awkward position in the depth of the wound. Although this required but ten minutes, you will note that the blood pressure fell from 115 to 90. We then placed the patient in the Trendelenburg position and observed an immediate rise of blood pressure. During the anastomosis of the ileum and colon the blood pressure remained good, but just as we began to handle the wound for closure, the blood pressure fell again, and the patient was given 1 mg. of strophanthin into the vein. I have found that this drug is helpful to maintain blood pressure, and I give it when the blood pressure falls below 100 and there is no reaction after lowering the head and giving subcutaneous salt. You will note on the chart in this case that both of these measures of protection had been employed. Just previous to this last fall in the blood pressure the patient showed cyanosis, and for this reason the gas was immediately discontinued and the remainder of the operation performed under local anæsthesia alone.

We have, therefore, in this case at the end of the operation, a moderate degree of shock from which the patient gradually and completely recovered. When the operation was completed on this individual she was relieved of a great handicap—the pyloric stenosis, the duodenal dilatation, and the toxæmia from the right giant colon. She could take and retain nourishment almost immediately. There was no toxic substance, such as ether, to be eliminated. From my experience, I would not have attempted this operation under ether narcosis. I am confident that in this individual a rapid appendectomy under ether would have been more serious than the operation as performed, and her convalescence more uncomfortable. I look upon this case as an extreme test of the method.

Fig. 3. This chart was made during an operation upon a male patient in good general condition. The right half of the colon was resected because of post-operative adhesions secondary to appendectomy. The patient suffered from pain and partial intestinal obstruction. When

there are adhesions about the colon it is more difficult to remove it without pulling on the parietal peritoneum, and it is very difficult to infiltrate large areas of this peritoneum. In this case this was apparently done successfully. The fall of the blood pressure to about normal as shown in the chart took place after all painful manipulations had ceased. The operation in this instance must have been painful, because you will observe that we had to give a little ether. Painful manipulations always at first increase the blood pressure. This patient, although in better general condition than the previous two, had a more uncomfortable convalescence which I attributed to the small amount of ether and the painful manipulations which we were unable to block. The details of this case will be discussed in a second paper already referred to.

FIG. 3.

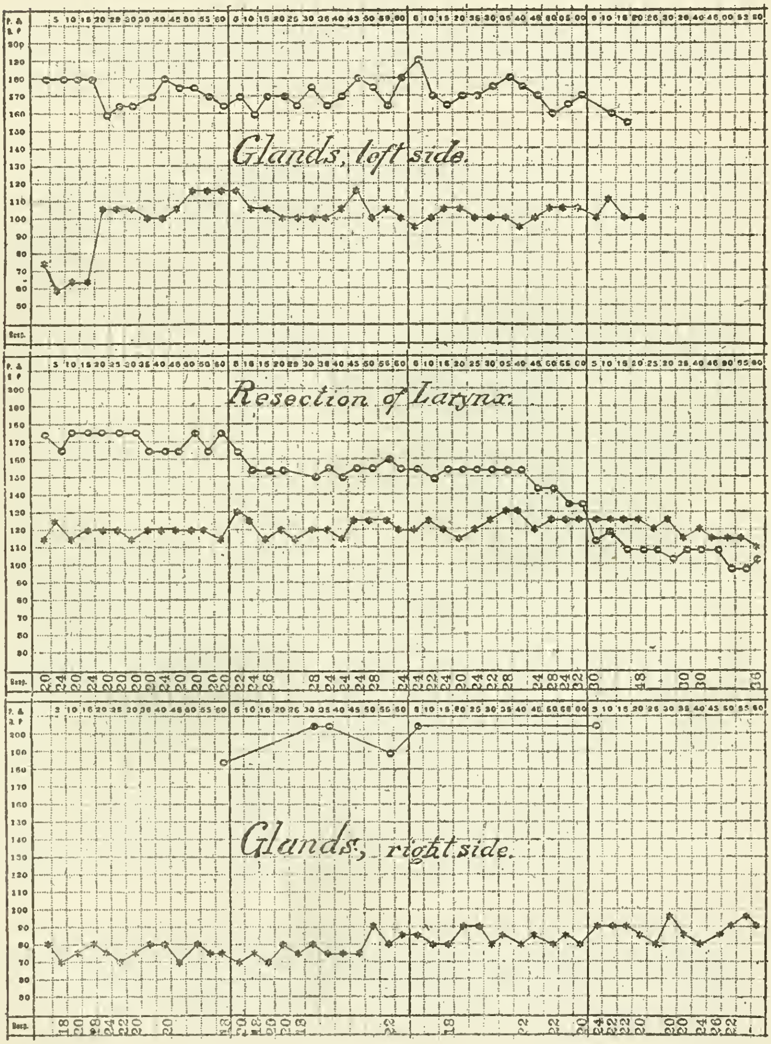


I do not feel that I have as yet accomplished the utmost in the local infiltration of the posterior parietal peritoneum and mesentery in the operation for resection of the colon and stomach.

Fig. 4. This chart portrays three separate operations—each of these done entirely under local anæsthesia with novocain.

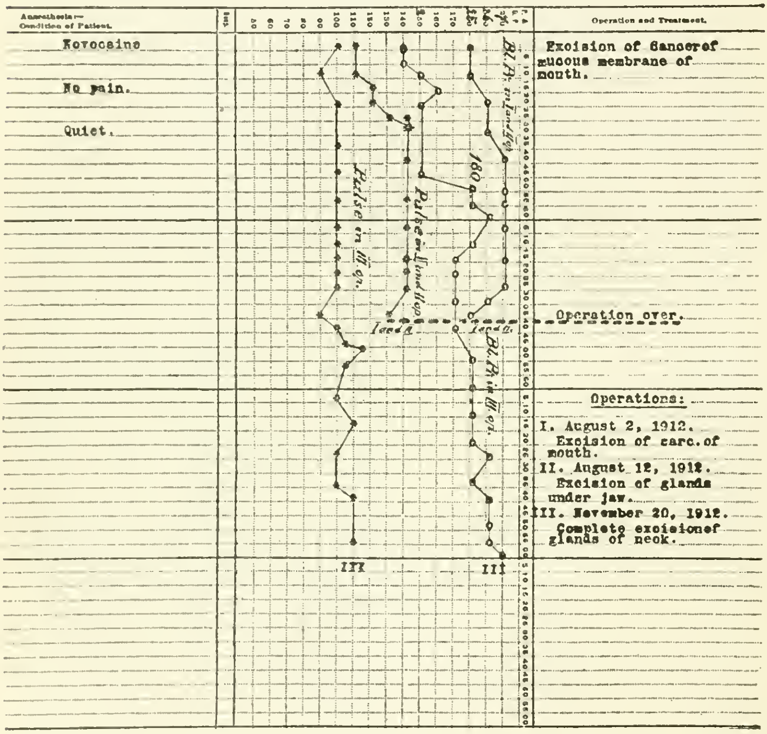
The patient was suffering from an advanced carcinoma of the larynx. The first operation consisted of the removal of the glands on the right side of the neck with the sternocleidomastoid muscle and internal jugular vein. All the nerve trunks coming out between the muscles of the neck were blocked. You will note that it was a long and tedious opera-

FIG. 4.



tion lasting four hours. The blood pressure in the first and last hour is not recorded, because the apparatus had to be used in another case. There was absolutely no post-operative shock, nor any complications. The record of the operation on the glands of the left side of the neck is complete—an identical operation with a similar result. The third operation consisted of the resection of the larynx performed without tracheotomy and with closure of the pharynx at the end. This operation was not absolutely painless, and you will note the fall in the blood pressure

Fig. 5.



after the third hour. The shock was slight, and the patient made an uncomplicated recovery. The only handicap in this case was the almost occluded larynx. For this reason I did not use a general anæsthetic.

Fig. 5 represents a composite chart of three operations under novocain alone. The handicap of this patient was a marked arteriosclerosis with high blood pressure, a crippled heart with marked dilatation of the aorta, albumen and casts in the urine, and a low kidney function. The pulse and blood pressure in the first two operations were so nearly alike that they are here recorded together. These operations required about one hour and forty-five minutes. You will note that in the third operation which required three hours, the pulse and blood pressure are lower. This may be explained from the fact that the patient, due to the rest and environment of the hospital had improved as far as his high blood pressure was concerned. The first operation consisted of the excision of a cancer of the mucous membrane of the cheek, the second of the removal of the glands under the left side of the jaw, the third of the removal of all the glands from mastoid to clavicle with the sternocleidomastoid and internal jugular vein.

Figs. 5 and 6 portray what is possible under local anæsthesia alone. Both patients had unusual self-control for local anæsthesia and desired to get along without a general anæsthetic because of the added danger.

My experience up to date with gas in high blood pressure has been most favorable, but not sufficient to test in this case (Fig. 6) if I could get along without it.

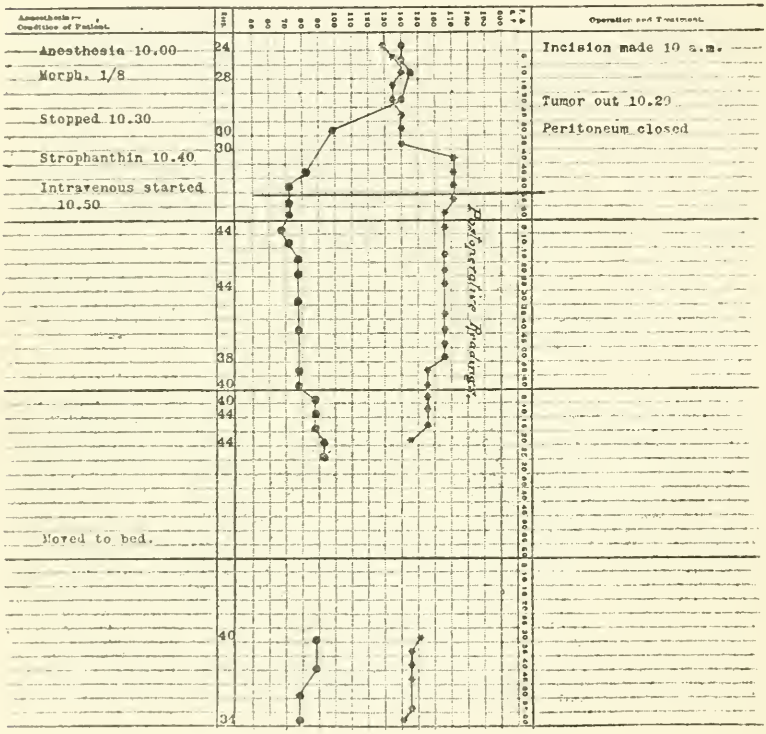
I shall reserve for a future communication the discussion of the apparent advantages of nitrous oxid and oxygen over ether in patients with high blood pressure.

Fig. 6. Here we have a graphic chart of shock due to trauma and loss of blood. This patient had a huge tumor beneath the psoas muscle in the left iliac fossa. It proved to be a benign fibromyxoma. He was taking 12 grains of morphine a day for pain when he came under my observation. I made up my mind to enucleate the tumor in stages, packing gauze between its capsule and the surrounding tissue. The chart was made at the last (tenth) operation. The final enucleation, you will note, required but twenty-five minutes. As the tumor was lifted from its bed there was profuse hemorrhage, and you will see the marked rise in the pulse and the fall in the blood pressure. Fortunately we were able to check the hemorrhage at once by packing. The patient recovered and is now well.

It seems unnecessary to reproduce here more charts. I look upon this paper as simply an introduction with the hope that it will influence you to try the method.

The final proof will rest upon a careful study of groups of operations of the same kind. These I propose to publish shortly. I feel convinced that I have sufficient evidence to prove that this method will be life-saving, if all the other factors of safety are considered, in operations in the late stage of intestinal obstruction; in patients who have to be operated on while in shock after an injury; in the late stages of perforated gastric and duodenal ulcer, and in typhoid perforations; in resection of the stomach and colon for ptosis; in resection of the stomach for cancer and ulcer in patients

Fig. 6.



weakened from prolonged pyloric stenosis; in the radical operation for cancer of the uterus; in the combined abdominal and sacral operation for cancer of the rectum. I think I can also show that the mortality will be decreased when less formidable operations are performed on patients handicapped with lowered kidney function, with sepsis, especially cases of cholangitis and jaundice; patients suffering with diabetes and arteriosclerosis; high blood pressure from various causes; in the presence of pneumonia and bronchitis; in patients feeble with advanced age.

I have not, as yet, had sufficient experience with infants and young children. I feel that in these cases local infiltration should be employed, but we may find that ether given by the drop method is just as safe. Our limited experience with children is due to the fact that the number of cases is small, and we have not yet perfected the mask. My experience with operations under the combined anæsthesia on children between five and ten years of age is most satisfactory.

TUMORS OF THE CAROTID BODY*

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AND

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A BODY 5 millimetres long, 3 millimetres wide and 2.5 millimetres thick, lying in the bifurcation of the common carotid artery, of doubtful embryological derivation, of undetermined function, inconstantly present, but occasionally giving rise to tumors of a definite structure—that is the substance of our knowledge of this gland, so-called. Because of this uncertainty as to embryological derivation or physiological function, carotid body seems a better term to use than carotid gland.

Anatomy.—The carotid bodies are found in embryos of 20 to 30 millimetres long. They are variable in size, shape and position, and may be absent on one or both sides in embryo or adult. They increase in size as the individual grows, because of increase of connective tissue, blood-vessels and parenchyma. Reaching a certain size between 20 and 30 years, they remain stationary for a time and then the connective tissue only increases. The interlobular blood-vessels thicken, and sclerosis and atrophy results. The consistence of the carotid body varies, but usually it is moderately hard and elastic. In color it varies from a reddish-gray to a reddish-brown.

When present, the carotid body is found most commonly a little posteriorly to the bifurcation of the common carotid artery, lying between the internal and external carotids, and more closely united to one or the other of these. It is attached to the one on which it lies by the "ligament of Mayer," through which it receives its blood supply. The body is surrounded by a dense fibrous (white and elastic) connective tissue capsule, from which prolongations are sent in, dividing the body into lobes, which are again subdivided into lobules. These delicate strands of connective tissue pass to the lobules and surround the "zell-ballen" of the Germans. These complete the alveolar arrangement of the structure, and are irregular groups of large, rounded or polyhedral cells, epithelioid in character, lying closely adjacent to the endothelial layer of the capillary tufts. They have a clear protoplasm, and contain large, round, well-stained nuclei. The afferent artery, running in the "ligament of Mayer," subdivides to pass to the lobes and lobules. Here it breaks up into a rich capillary network or tuft lying about and intimately associated with the "zell-ballen."

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* Read before the New York Academy of Medicine, April 23, 1913.

The nerve supply is abundant and is connected with both the cranial and sympathetic systems. It receives branches from the vagus and glossopharyngeal, superior laryngeal, and superior cervical sympathetic ganglion. Fibres pass from the vagus, glossopharyngeal and sympathetic to form a plexus in the angle of bifurcation just in front of the carotid body. Many fibres from this plexus penetrate the capsule of the organ. The capsule contains both medullated and non-medullated fibres, and these pass in freely to the glomerular tufts and "zell-ballen." Ganglion cells are scattered and few in number.

Embryology.—That the carotid bodies are derived from the sympatho-chromaffin system anlage, which buds off from the central nervous system in embryos of 20 to 30 millimetres, is the view expressed by Zuckerkandl.[2] He says: "The glandula intercarotica is associated with the plexus intercaroticus. That it belongs to the chromaffin system was recognized by H. Stilling. . . . Any attempt to derive this gland from a branchial pouch or from a thickening of the wall of a vessel must fail, since chromaffin cells can only be produced from sympatho-chromaffin tissue. . . . A. Kohn derives the chromaffin elements of the glandula intercarotica from the nerve anlage which passes from the upper cervical sympathetic ganglion between the two carotids. In a 44 millimetre pig embryo he finds in this plexus ganglion cells, some of which have a large and feebly staining nucleus, and believes that these latter cells represent the specific elements of the carotid gland. Up to this time only scattered observations have been made on the glandula intercarotica in man. R. Paltauf investigated an embryo of 15 millimetres and a fœtus of 45 millimetres. In the former the gland had not yet appeared, but it was present in the latter. According to Kohn, the cells of the anlage of the gland in a 19 millimetre (N. L.) embryo resemble neither the small, deeply staining ganglion cells of the intercarotid plexus nor the chromaffin cells." McMurrich,[3] Bailey and Miller,[4] and Heisler,[5] agree with this view as to the derivation of the carotid body. Keith [6] does not definitely commit himself, but suggests a derivation from the sympathetic nervous system.

Of historical interest is the view, supported by Steide,[7] Rabl,[8] de Meuron [9] and others, that they are derived from the third or fourth branchial cleft; and the later view of Kastschenko,[10] Paltauf,[11] and Monckeberg [12] and others, that they are derived from the perithelium of the carotid arteries.

The above view of Zuckerkandl is strongly supported by Stilling's [13] demonstration of cells in the " cell balls " and in the stroma cells which stain brown with neutral salts of chromic acid. Kohn [14] confirmed Stilling's observation and calls these " chromaffin " cells. Similar cells are found in the medulla of the adrenal, in the pituitary and in the ganglia of the sympathetic nervous system. This group of structures, including the carotid bodies, is referred to as the " chromaffin " system.

Physiology.—As to the physiology of the carotid body there is but little positive knowledge. All investigations have proceeded along the line suggested by Stilling's demonstration of chromaffin cells in its substance. As the type of the chromaffin system, the suprarenal capsule, has to do with the regulation of blood pressure, as judged by its extract, the investigations into the function of the carotid body have been conducted along that line. Mulon,[15] in 1904, prepared a watery extract of the carotid bodies of horses. With this, by injecting it into the veins of rabbits, he was enabled to produce a rise of blood pressure, and sometimes an acceleration of the force and rate of the heart beat. Gomez,[16] working in 1907 and 1908, prepared a glycerin extract of carotid bodies. With this he produced a fall of blood pressure in cats.

Frugoni,[17] in 1911, 1912, and 1913, prepared an extract of carotid bodies of young sucking calves in Ringer's solution, 4 c.c. of which was equivalent to the carotid bodies of a calf. By injecting this into the veins of rabbits, he was able to certainly cause the death of a rabbit of medium size with 4 to 6 c.c. Death occurred in about five minutes, and the prelethal symptoms were inconstant convulsive seizures, respiratory paralysis, arrest of circulation, and hyperæmia of internal organs (anaphylaxis?). Intravenous injection of non-lethal doses caused a slight initial rise of blood pressure, followed by a fall of 20 to 30 millimetres of mercury. These phenomena are accompanied by feeble respiration and weak pulse. The same effects were obtained after severing the vagus and other depressor nerves. With isolated organs he was able to demonstrate a vasodilator effect. On the whole, he doubts the existence of an important internal secretion.

Its not constant presence, the contradictory results of experimental work, and the lack of clinical observation, indicate that the function, whatever it may be, is not important. However, the different parts of the chromaffin system, while of common embryology, possess different functions. Thus, the medulla of the adrenal affects blood pressure, the cortex has to do with the development of the sexual apparatus, the pituitary seems to exert a trophic influence, etc. These varying functions of the different parts of the chromaffin system, together with the fact that the carotid body atrophies at or soon after puberty and full body development, suggest that when its function is established it will be in some way connected with trophic stimuli in body development.

Pathology.—Pathological studies on the carotid bodies are limited to the tumors, of which 60 have been reported, including the one described at length in this paper, and four cases furnished by prominent New York surgeons. Gomez[16] observed some cases of sclerosis of the body, particularly in cases of arteriosclerosis, but this was not more marked than the change in the intima of the arteries in other locations. I have recently had an opportunity of observing a case of tumor of the carotid body occurring in the service of Dr. John Edmund MacKenty, at the Manhattan Eye, Ear and Throat Hospital, where the patient applied for relief from the throat symptoms. These observations and the study of the case form the basis of this paper.

Clinical History.—The patient, P. McD., male, Irish, driver, aged forty-one, presented himself at the clinic on January 14, 1913, for a tumor of the neck, with aphonia and difficult breathing, pain in the throat and difficult swallowing.

The family and past history were negative. The present illness began four months previously with loss of weight and increasing weakness. Six weeks previously he had noticed a hard tumor on the right side of the neck. The subjective symptoms had been noticed three weeks previously. In the four months he had lost twenty pounds in weight and had been compelled to give up work on account of weakness.

Examination.—Patient was a large robust man of 170 pounds. There was no marked evidence of cachexia. On the right side of the neck a hard tumor extended from the level of the angle of the jaw above to the clavicle below, and from the thyroid gland internally well into the posterior triangle. On palpation this tumor was board-like in hardness, there was no pulsation, and it was not movable in any direction, although the skin was freely movable over it. Auscultation over the tumor did not show any increase in the carotid bruit. Laryngeal examination showed paralysis of the right cord, and the larynx was displaced to the left. The chest was negative; pupils equal and reacted to light; no involvement of the facial nerve. The Wassermann and Noguchi reactions were negative.

He was sent to the hospital and a fragment of the tumor removed for diagnosis. In the laboratory this was divided into two parts, one of which was hurried through the fixing solutions, the other being carried along slowly to secure more perfect fixation. The first part, cut into thick sections, showed a lymph node, much of which was normal or nearly so in structure. In places where the capsule was absent there was a definite infiltration of the surrounding fatty tissue with small, dense, closely packed round cells. From this appearance, and the definite, sarcoma-like tumor, a diagnosis of probable lymphosarcoma was made. The second piece, which was not sectioned until after operation, revealed a structure such as will be described below.

On the basis of this report the patient was readmitted to the hospital on January 23 for operation. The incision was carried along the anterior border of the sternomastoid from the angle of the jaw to the clavicle, and along the superior border of the clavicle to the trapezius. The skin, superficial and deep fascia, and the sternomastoid, were reflected in one flap. Raising this flap revealed a tumor extending from the upper border of the hyoid bone above down to and under the clavicle below. Anteriorly it was in contact with the thyroid gland, while posteriorly it extended to the transverse processes of the cervical vertebræ. Roughly the tumor was 14 centimetres long by 10 centimetres wide. The neoplasm was covered with a fibrous capsule. The surrounding tissue was adherent to the capsule, however, so that the line of demarcation was not sharp. It was lobular, dense, slightly elastic, friable. In color it was reddish-gray to red on section. An attempt was made to dissect it up from behind, but the growth was found to include the common carotid artery, internal jugular vein, pneumogastric and recurrent laryngeal nerves, and this attempt was abandoned. An incision was then made in the course of the common carotid artery and down to the artery and sheath, and an attempt was made to dissect the mass away from these structures. The neoplasm was so firmly adherent, however, that this was impossible. The portion of the tumor anterior to the vessels was then dissected away; hemorrhage, which had been free and troublesome, but not dangerous, was checked, drainage inserted and the wound closed. The exposed common carotid was irregularly eroded and had the appearance of a badly rusted iron pipe.

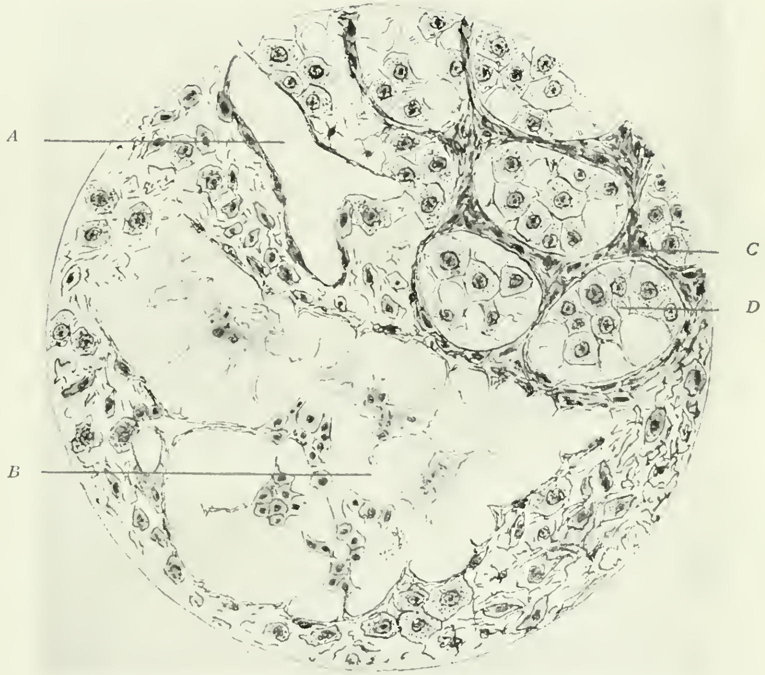
Recovery from the anæsthesia and post-operative shock was rapid and complete. There was no increase of laryngeal paralysis, and no lung complications. The patient did well until January 30, when erysipelas intervened, with wound infection. There was rapid sloughing of flaps, with destruction of tissue, and the patient continued to grow weaker. On February 8 there was a slight hemorrhage from the wound. On the 9th a more severe hemorrhage necessitated tight packing, and there was a continuous troublesome oozing. On the next day the patient was taken to the operating room to stop the bleeding, which now had become serious. When the packing was removed and the wound opened there was a violent hemorrhage. A finger was inserted into the bleeding point to stop the hemorrhage and it entered a hole in the common carotid. Ligatures were placed below and above the bleeding point. An intravenous infusion of 1000 c.c. of saline was given and the patient returned to the ward. The next day, February 11, the patient suffered from a left-sided paralysis, was comatose, and gradually weakened till death on February 13, three weeks after the operation.

Pathological Findings.—The tissue sent to the laboratory was an irregular, torn mass half as large as a man's fist. In color it was red to reddish-gray. The torn surface presented a succession of lobules, appearing much like a mass of fish-roe. Extending over one side was a dense capsule, but no lobed appearance was visible. The specimen was hardened in formalin and alcohol, and embedded in celloidin and paraffin. Sections were stained with hæmatoxylin and eosin.

On microscopical examination the sections presented along one side a thick connective tissue capsule, with connective tissue bands extending from this into the depth of the tumor. These bands divided and subdivided, forming an alveolar structure. The connective tissue cells of these septa and of the capsule were long spindle-cells of sharp outline, with a lance-shaped, slightly vesicular nucleus. Scattered through these bands in groups were many younger connective tissue cells, without definite cell body, and with oval, vesicular nuclei.

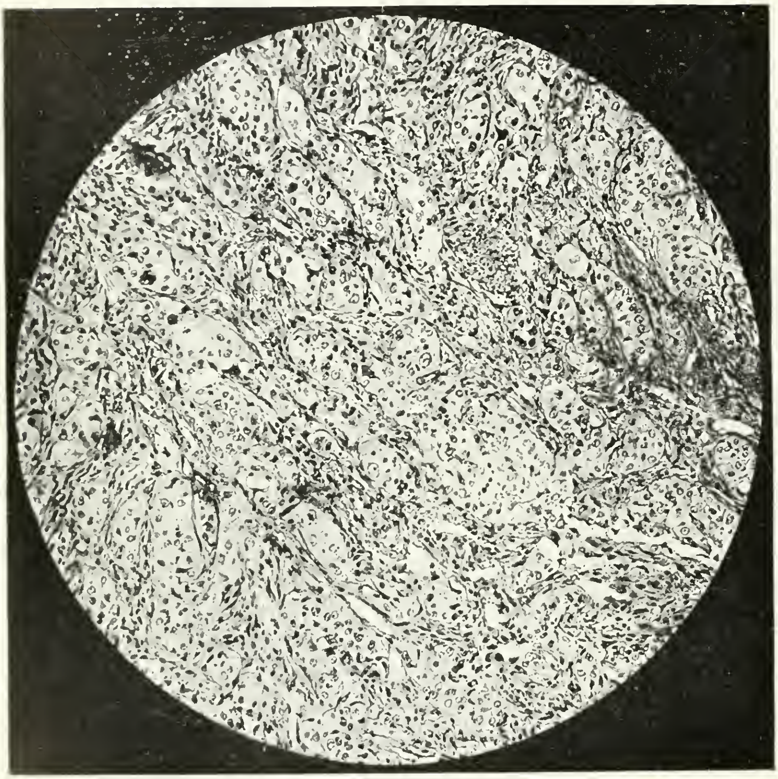
The vascular supply of the tumor was abundant but anomalous. At no place were there well-formed blood-vessels, but the appearance was rather a succession of new formed blood spaces. Those running in the connective tissue stroma had a poorly defined vessel wall and were lined by irregular, jagged endothelial cells. Those in more intimate relationship with the alveolar part of the neoplasm presented only the endothelial lining, and the picture was the same as will be described in connection with the alveoli. Capillaries were present everywhere in the tumor, but were particularly abundant in those parts of the new growth which were richest in fibrous bands and septa. Many of the smaller

FIG. 1.



Composite drawing of typical fields of the tumor. *A*, blood space in intimate relationship with the cells of the alveoli; *B*, embryological remnant of gland; *C*, newly formed connective tissue cells making up the trabeculæ; *D*, vesicular cells filling the alveoli.

FIG. 2.



Microphotograph of tumor of the carotid body. Magnified 120 diameters.

blood spaces and capillaries had only a thin membrane between the lumen and the cellular elements.

The alveolar arrangement varied in different parts of the tumor. In places near the capsule the alveolar structure was regular and definite, while in older parts of the neoplasm this shaded off to a more diffuse, sarcomatous appearance. Some of the cell groups were round or irregular in shape, while others appeared as columns of cells. But always, due allowance being made for the variations present in malignant growths, the structure was the same. The relationship between the tumor cells proper and stroma was definite and intimate, fibrils seeming to pass from the stroma between the cells of the alveoli, and in places fibrils seemed to pass out from these to join the stroma. The cells in the alveoli were large and irregularly polyhedral. The centrally placed nucleus filled but a small part of the cell. The nucleus was round or oval in shape, was vesicular, possessed a prominent nuclear membrane and a well-marked nucleolus. About this was a fibrillar network of protoplasm. From the angles of these polyhedral cells fibrils seemed to pass between adjoining cells and into the stroma. The size of these cells varied, but not more so than is usual in rapidly growing neoplasia. Evidences of mitosis were present in both stroma and the enclosed cell groups, but more frequent in the latter. Some of the alveoli seemed to be grouped about or were intimately related to the blood spaces. In such places there was a layer of intimal cells. Outside of this were one or two layers of smaller spindle-shaped to polyhedral cells and then the alveolar cell nests. Within and between the cells of the alveoli were many vacuole-like spaces. Those within the cells were doubtless artefacts of fixation, but those between the cells present some evidence of being blood spaces. Monckeberg pictures them as such, but I think in my preparations the evidence was not conclusive. Whether his sections presented clearer pictures of this than my own, I am unable to say.

Occasionally, there were small areas of the tumor resembling the embryological carotid body. These consisted of wide blood spaces without walls, within which were columns of polyhedral cells. These resembled in structure the columns of cells and blood spaces of the liver. except that in proportion to the cells the blood spaces were much wider.

On the whole, the appearance was that of an endothelioma, but in places the structure was that of a loose sarcoma. The sections were variously diagnosed by competent men as carcinoma, sarcoma, endothelial sarcoma and endothelioma. This latter agreed with my own opinion, but I was never quite satisfied. When I took sections to Prof. James Ewing, of Cornell University Medical College, he suggested a tumor of the carotid body. Comparison of the structure of the tumor in this case with other reported tumors of the carotid body convinced me of the correctness of this diagnosis.

The Literature.—American literature on the carotid body begins with the careful paper by Keen and Funke[1] in 1906.

Previous to this Charles L. Scudder, of Boston, reported a case of tumor of the carotid body in 1903, and Funke and McPhatter each one in 1904. Keen and Funke collected 27 cases in the living and two cases which had been discovered at autopsy. I have been able to collect 31 additional cases, 28 cases in the living, one examined at autopsy, although known to exist before death, and two discovered at autopsy. These are, numbering consecutively with Keen's cases, as follows:

30. Cecca.[18]—The patient, a man forty years of age, about four years previously had begun to notice a small pulsating tumor in the right carotid region. This slowly attained the size of a hazel-nut. There was an autopsy, as the man died of pneumonia. The tumor was found to be inclosed in a thick fibrous capsule, lying at the bifurcation of the common carotid, and was closely connected with the common carotid by a vascularized pedicle. The microscopic examination showed the tumor to be a primary angiosarcoma, which had developed at the expense of the carotid body.

31. Rivet.[19]—A woman, forty-nine years old, seven years previously had first noticed a swelling the size of a hazel-nut, at the level of the jaw, behind the ascending ramus. It was not painful, but had recently grown to the size of a turkey's egg. The skin over it was movable, and the pulsations of the external carotid could be felt through it. At operation the tumor was dissected away from the carotid arteries. There was free hemorrhage, and after the operation there was aphonia and difficulty in swallowing. The removed tumor had the appearance of a goitre, but on consulting the literature it was identified as a tumor of the carotid body. The clinical diagnosis had been a parotid tumor or aberrant thyroid.

32. Cook.[20]—The patient, J. W., a mulatto, aged 29, had a slowly growing, painless lump on the side of his neck. This was a large mass extending from the tip of the mastoid to the level of the cricoid cartilage, and from the side of the thyroid gland to within 1.5 inches of the ligamentum nuchæ. The mass had a peculiar, elastic feel, was slightly compressible but not movable, and had a pulsation synchronous with the heart beat and expansile in all directions. A harsh bruit was heard over the left common carotid, beginning beneath the clavicle and extending to the tumor, while over the tumor a softer murmur was heard. At the operation hemorrhage was troublesome from the beginning, there being a constant oozing which could not be controlled with hæmostats. The carotid arteries and internal jugular vein were ligated, but this did not control the hemorrhage. The patient died within an hour of the operation. The removed tumor was 7 x 5 centimetres in size. Only in places was there a definite capsule. It was dark red on the surface;

on section, pearl gray tinged with red. The clinical diagnosis was probable carotid aneurism.

33. Cathcart.[21]—The patient, a white male, aged thirty-three, was operated on two years before the case was reported. When first seen there was a firm, movable tumor on the left side of the neck the size of a pigeon's egg, but two months later this had increased to the size of a hen's egg. This mass was not tender and he complained of no pain. There was some interference with swallowing, and he was deaf on the left side. At the operation there was free bleeding from the whole exposed surface, and as this could not be controlled it was found necessary to ligate the common, internal and external carotids. This new growth extended from half an inch below the bifurcation to two inches above, and surrounded all three arteries. The tumor and arteries were removed intact. As the jugular vein and pneumogastric nerve were not involved these were not injured. There was a well developed fibrous capsule sending septa within the structure, dividing it into alveoli-like spaces. There was no recurrence in two years. No diagnosis was made previous to operation.

34. Zondek.[22]—In the case of a man sixty-three years of age a tumor had been noticed for nine years. It was on the right side of the neck at the level of the larynx. The swelling, which surrounded the common carotid at its bifurcation, gave rise to no symptoms, aside from a slight sensation of pressure. At operation the carotids were all ligated and cut. The patient made a good recovery, and was discharged three weeks after operation.

35. Licini.[23]—A man, aged twenty-eight, had a tumor on the right side of his neck for nine years. After the tumor had existed for five years, under the impression that it was an enlarged gland, the pulsating mass was incised. There was free hemorrhage and a diagnosis of angioma was made. As the tumor continued to grow, and caused pain and dysphagia, the patient travelled from his home in Brazil, to Kocher, in Berne, Switzerland, to be operated on. On the basis of its location in the bifurcation of the common carotid artery, which could be traced through the tumor by palpation, and on the pulsation and elasticity, Kocher made a diagnosis of tumor of the carotid body. A tumor the size of a hen's egg was dissected out of the angle of bifurcation, which had been much widened by its growth. It was bluish in color and had the appearance of a soft sarcoma. The patient made a good recovery. On the basis of the histological findings it was called a "struma" of the intercarotid gland.

36. Beitzke.[24]—This case of tumor of the carotid body was found accidentally at the autopsy of a woman fifty-six years of age. It had caused no symptoms during life, and the woman's death was due to severe general pemphigus complicated by pneumonia. A brownish-red tumor the size of a plum, of moderately solid consistence, was found in the angle of bifurcation of the left carotid artery. It was surrounded by a fibrous capsule, and was closely applied to the branches of the carotid, which showed no changes aside from a few yellowish spots,

the size of a lentil, on the intima. Upon the basis of the histological findings, the author proposes to designate this form of tumor as "struma of the carotid gland," or "struma intercarotica."

37. Douglas.[25]—A. E., female, aged twenty-three years, American. The tumor was painless, but increased slowly in size. There were no symptoms until one week before operation, when hoarseness developed. He found a mass 3.5 x 2.5 x 1.5 centimetres on the right side of the neck at the anterior border of the sternomastoid muscle. This was firm, smooth and freely movable laterally but not vertically. The skin was freely movable over the tumor, it was not tender, and a slight transmitted pulsation could be felt. At operation this tumor was found in the bifurcation of the common carotid artery. The capsule, which was exceedingly vascular, was adherent to the sheaths of the vessels, but was removed without injuring them or any of the nerves. Paralysis of the left vocal cord followed the operation, but recovery was complete. The clinical diagnosis before operation was tuberculous cervical lymph gland. The pathological diagnosis, by Dr. Norris, of Bellevue Hospital, was perithelioma of the carotid body.

38. Coley and Downes.[26]—The patient, a man thirty-five years of age, four months before admission to the hospital noticed a swelling in the left sternomastoid muscle near its insertion. There was some difficulty in breathing while sleeping, and during the last two or three days there had been pain, in the muscle rather than in the tumor. Examination showed a tumor the size of an egg, on the left side of the neck, just internal to the angle of the jaw and apparently lying beneath the upper portion of the sternomastoid. It was smooth and symmetrical in outline, firm in consistence, and not tender. Examination of the pharynx showed a similar swelling on the left side nearly as large as the external tumor, pushing the tonsil and uvula over to the right side. At operation the external carotid and several branches were ligated. The tumor, exceedingly friable and matted to surrounding structures, was removed piecemeal, partly with a curette. The vessels were distorted, soft, and eroded. Recurrence took place promptly, and death occurred after four months. The removed tumor was of an alveolar type, and very malignant, causing death in eight months from the time it was first noticed.

39. Coley.[26]—L. P. F., male, aged fifty-three, had a small tumor in the left parotid region for six years. This tumor, hard, painless, slightly movable, caused no inconvenience. As the tumor seemed to be getting larger and less movable, an operation for its removal was performed March 30, 1906. The deeply situated mass was enucleated, carrying with it the buccal branch of the facial nerve, which was entirely embedded in the growth. Paralysis of the buccinator and levator anguli oris occurred on the day following the operation, succeeded soon afterward by inability to close the left eye, and a little later by difficulty in pronouncing the letter "p." Later there was almost complete paralysis of the facial nerve and some branches of the fifth. The tumor recurred locally, followed by death in eight months with symptoms of brain involvement. Microscopically the tumor is described as a "a sarcoma of the mixed-cell variety.

A great part of the tumor is made up of fibrous tissue, which more or less surrounds the sarcoma cells. In the centre of the sarcomatous areas are patches of degeneration. The alveolar arrangement of the large sarcoma cells lead one to conclude that their origin is from the tissue surrounding the blood-vessels."

40. Green.[27]—Miss A., aged seven, had a tumor the size of a pullet's egg on the right side of the neck, just beneath the sternomastoid muscle, on a level with the bifurcation of the common carotid artery. It had been growing very slowly for two years, but gave rise to no symptoms. The tumor was removed by ligation of the three carotids, which it involved. This was followed by right sided paralysis, from which she never entirely recovered. The tumor was very vascular and bled freely.

41. Green.[27]—Mrs. B., aged forty-five, had had a slowly growing tumor on the side of her neck for 17 years. It was lying beneath the anterior border of the sternomastoid muscle, was movable, elastic, and slightly pulsating. At operation it was found to extend from the angle of the jaw to near the clavicle. It was bluish in color and very vascular, bleeding freely whenever injured. The carotids were surrounded and the internal jugular vein and pneumogastric nerve were attached to its surface. As removal would have involved ligature of all the carotids and the internal jugular vein, with probable injury to the pneumogastric, hypoglossal, glossopharyngeal and descending noni nerves, it was left *in situ*. The clinical diagnosis had been a vascular tumor. Neither of Green's cases were examined histologically.

42. Makara.[28]—A boy eighteen years old, had, two years previously, first noticed a small tumor on the right side of his neck. At the time of operation this had reached the size of a pigeon's egg, and interfered with swallowing. The tumor was excised by ligation of the common, internal and external carotids, the jugular vein and nerve trunks being preserved. On the second day after operation the patient developed fever, promptly followed by hemiplegia and dysphagia. Death resulted on the third day from softening of the brain due to interference with the blood supply. The removed tumor was 4 x 3.2 x 3 centimetres, enclosed in a fibrous capsule. Histological examination showed the usual alveolar structure of a tumor of the carotid body. The clinical diagnosis had been an accessory thyroid.

43. Alezais and Peyron.[29]—These authors report a case of malignant degeneration of a tumor of the carotid gland. The tumor, discovered at the autopsy of an adult, was adherent to the three carotids, the internal jugular vein, and the aponeurotic muscular sheaths. In places there was the ordinary perithelial type of neoplasm of the carotid gland; in other places a tumor of the type of pavement epithelium, tubular or lobulated. The two types were intermingled, but the first type was more abundant near the periphery, while the second type was more abundant in the deeper parts. The cortical layers contained areas showing transition from the usual type of carotid gland tumor to the epithelial type.

44. Kuznetsoff.[30]—A female, aged forty-eight, had a right-sided tumor which had existed for two years, and which grew rapidly in the past six months. There was a swelling the size of a walnut in the course of the common carotid artery, which was movable laterally but not horizontally. She suffered occasionally from sticking pains. The patient was operated on in 1907. The external carotid was ligated, the tumor being dissected away from the other carotid arteries. The removed tumor was encapsulated, and was the size of a large plum. Recovery was complete without complications. The clinical diagnosis was between a cervical lymph adenitis and a tumor of the carotid gland.

45. Ligin.[30]—Kuznetsoff refers to a case in which he assisted a Dr. Ligin to remove a tumor from a young soldier. It had been necessary to resect all the carotids. He classes it as a tumor of the carotid gland with recovery.

46. Dobromisloff.[31]—A male, forty-one years old, had a left-sided tumor for 17 years, with rapid growth for one year. This tumor was in the superior carotid triangle. It was operated on in 1900 by Salishteff. All three carotids were ligated and removed. The internal jugular vein and pneumogastric nerve were cut. The tumor grew about the common carotid artery, and when removed it was egg-shaped, 7 x 5 x 4 centimetres in size, very firm, reddish-gray on section. It had been diagnosed as a tumor of the thyroid gland. Death occurred one day after operation.

47. Dobromisloff.[31]—A female, aged twenty-five, had a tumor on the left side of her neck for seven years. Two years previously it had taken on rapid growth. It was located at the bifurcation of the common carotid, beneath the sternomastoid muscle, and extended up to within a finger's breadth of the lobe of the ear. The larynx was displaced to the right. There was transmitted but not expansile pulsation. Lateral movement was free, but vertical movements were restricted. At operation, in 1906, many veins were ligated and the arteries dissected out. While the posterior portion was being dissected hemorrhage was free. It was an encapsulated tumor 9.5 x 8 centimetres. The patient recovered, but the left pupil remained dilated and the conjunctiva injected.

48. Woolley and Fee.[32]—A woman, sixty-eight years old, had suffered from goitre five years. Two years ago she noticed a tumor on the right side of her neck. When examined it was 2.5 inches long by 1.5 inches wide. The larynx was pushed to the left. When the patient was examined on her back a bruit was heard over the tumor, but when her face was down this disappeared. There was a transmitted but not expansile pulsation. Vertical movement was free, but there was no horizontal movement, as the tumor was attached to the thyroid gland. The consistence was that of a large, non-pulsating lymph gland. At operation the tumor was removed, together with the bifurcation of the common carotid artery. The removed tumor was 6.5 x 3 x 3 centimetres and weighed 35 grammes. On microscopic examination there was distinct evidence of a sarcomatous change occurring in the tumor.

The patient did well for a while after the operation, but died 23 days later from an apparent septicæmia.

49. Sinushin.[35]—In a paper read before a Moscow medical society Sinushin refers to a second case coming under his observation. The patient was a woman forty-eight years old, and the report was made two years after the operation. There were no symptoms other than a gradually increasing swelling. At operation a typical tumor of the carotid body was found in the bifurcation of the common carotid artery, pushing the branches wide apart. The data given is very meagre, but gross and microscopic photographs leave no doubt as to the nature of the growth.

50. Chiari.[36]—The patient, a man thirty-nine years of age, had noticed a tumor the size of a hazel-nut on the left side of his neck three and one-half years previously. It was smooth, freely movable, and the only symptom was a slight burning sensation. After a few months' duration it began to grow slowly, and about once a week he had attacks of pain radiating to the left side of the chest. As the tumor continued to grow these attacks became more frequent, often occurring several times in the 24 hours, and the pain became so intense the patient was unable to work. On examination Chiari found, in a position corresponding to the bifurcation of the common carotid, a hard smooth tumor the size of a pigeon's egg. It was only slightly movable, and a transmitted pulsation could be felt through it. At operation the tumor was matted to the surrounding tissues. The external carotid was ligated, and the descending branch of the hypoglossal nerve divided. The tumor was then dissected away from the internal carotid and lifted out of the widely distended angle of bifurcation. Microscopical examination revealed the usual structure of tumors of the carotid body. He rejects the idea of a hyperplasia of the normal gland, as not all the elements of the normal structure enter into the tumor formation. Notable is the absence of ganglion cells in the tumor.

51. Hollaender.[37]—On May 22, 1912, Hollaender demonstrated a tumor of the carotid body before the Berlin Medical Society. The tumor, the size of an egg, had occupied the upper triangle on the left side of the neck of a young actress. The only complaint of the patient was the disfigurement, but on examination a mild exophthalmus was observed. The larynx was displaced to the right. At operation the tumor was found to surround the external carotid, but was dissected away from it and the widened angle of bifurcation without sacrificing either of the carotids or any of the nerves. A mild disturbance of the recurrent nerve persisted for several days, but disappeared completely. No diagnosis was made previous to operation.

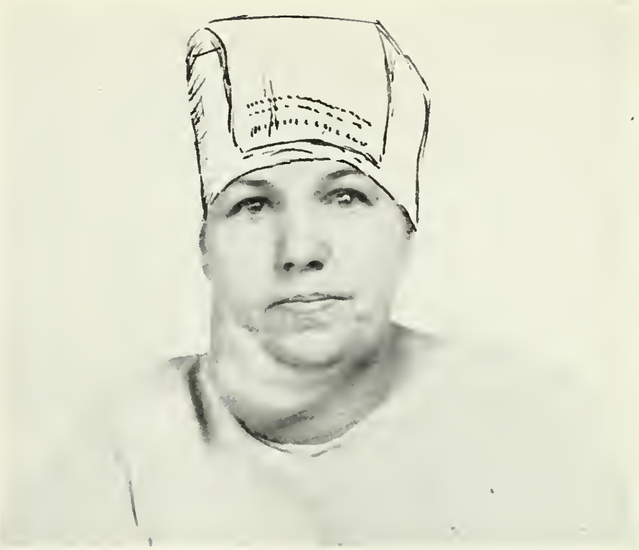
52. Randisi.[38]—The patient, a woman fifty-five years of age, nine years previously had noticed a tumor on the right side of her neck, at the level of the thyroid cartilage. This swelling had very slowly increased in size, but aside from the deformity there were no symptoms. At examination there was a tumor the size of a lemon, of regular, rounded shape, and elastic on palpation. There was a faint pulsation, transmitted but not expansile. As aneurism and malignant growth could be ruled out from this history and the

examination, an operation was decided on. The tumor was found lying on the anterior surface of the carotid arteries, involving the upper two-thirds of the common and a considerable distance along the internal and external. Paralysis of the right vocal cord followed the operation, although there had been no injury of the recurrent laryngeal nerve. From the histological examination the author calls the tumor an angiomyxoperithelioma.

53. BONI.[39]—A woman, thirty-four years of age, four years previously had first noticed the presence of a small swelling on the right side of the neck. This was the size of a small nut, was free from pain, spontaneously or elicited by pressure, and it was on a level with the angle of the jaw. Four months before coming under observation this tumor began to enlarge, became painful, and the patient became conscious of pulsation. On examination a soft, elastic tumor the size of an orange was found, pulsating synchronously with the carotid artery. It was somewhat reducible on pressure, but did not fluctuate. The location of the tumor in the bifurcation of the carotid, its intimate relation with the artery, the pulsations of which it transmitted, suggested a tumor of the carotid body. The tumor was removed by ligation of the common, external, and internal carotids, the jugular vein and pneumogastric and sympathetic nerves being dissected away from it. There were no post-operative sequelæ, and the patient remained well at the time of the report, two years after the operation. The histological examination suggested a fibrohæmangio-endothelioma. The author is in doubt as to the correct histological diagnosis, and leaves the question open as between a carotid perithelioma and a carotid adenoma.

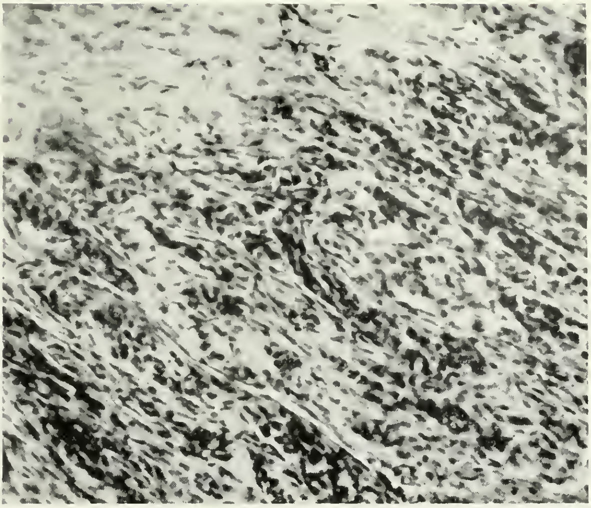
54. MATHEWS.[40]—The patient, H., a male, twenty-five years old when first seen, was unable to definitely fix the appearance of a tumor on the left side of his neck, but thought there had always been a fulness there. The history, however, was quite definite of a growth for three years. In recent months there had been a modification of the voice. Examination showed a man in fairly good health. There was a swelling under the left sternomastoid muscle, which was ill defined and extended upward to the jaw and base of the skull and downward to the thyroid cartilage. Over this there was a bruit synchronous with the carotid pulsation. Pressure over the carotid suppressed the bruit, but did not reduce the size of the tumor. The left tonsil protruded to the median line, was smooth, not inflamed, and hard. The left side of the tongue was paralyzed and atrophied. Dr. Mathews attempted an operation at the General Memorial Hospital on May 9, 1911. The external jugular vein was ligated, and some pieces were removed from the mass, which infiltrated the surrounding tissue, leaving no definite outline to the tumor. Venous bleeding was profuse, although the internal jugular was about empty. As removal of the entire growth would have required extirpation of the common, internal and external carotids and the internal jugular vein, with all the important nerves of that side, and probably also the lateral wall of the pharynx, the wound was closed, leaving the tumor *in situ*. Primary union followed. This patient visited Dr. Duncan

FIG. 3.



Dr. Lilienthal's first case. Endothelial tumor of carotid body, long standing. Note absence of cachexia.

FIG. 4.



Dr. Mathew's case. Microphotograph of section removed at time of operation.

MacPherson in the summer of 1913 for a growth in his left ear, which was removed at the Post-Graduate Hospital July 1, 1913. The operation was interfered with by the severe pulsatile bleeding. No histological examination was made of the growth, owing to loss of the specimen. Following a positive Wassermann, two injections of salvarsan were given with some apparent improvement. The patient continues to work as a street-car conductor, but has a contracted pupil on the left side and there is a stiffness of the neck. (Microscopical examination of a poorly prepared section from the mass removed by Dr. Mathews convinces me this is an undoubted tumor of the carotid body.) (Presented before the New York Surgical Society, October 22, 1913.)

55. DaCosta.[41]—March 3, 1913, before the Philadelphia Surgical Society, DaCosta presented a specimen of a tumor of the carotid body, which he had removed from a woman thirty-six years of age. The tumor had been noticed 16 years previously, but growth had been slow until six months before operation. During this six months the tumor had grown more than in the 15½ years before that time. The diagnosis, made before operation, was based on the slow growth for years; the carotid pulsation, which lifted the tumor at every beat of the heart; the absence of expansile pulsation; the free movement laterally but not vertically. The tumor, the size of an English walnut, was removed by ligation of the external carotid, it being dissected away from the internal carotid and jugular vein. The pathological diagnosis was perithelioma.

56. Lilienthal.[42]—A woman, M. C., about thirty-eight years old, was admitted to Mt. Sinai Hospital in April, 1906. Ten months before she had first noticed a tumor the size of a marble which at first increased slowly in size, but for ten weeks before admission had grown so rapidly that when she entered the hospital it was enormous, extending from the trapezius posteriorly across the median line in front. There were severe "neuralgic" pains in the head and there was hoarseness from paralysis of the right vocal cord. The tumor felt hard and solid but was not attached to the skin. There was no discoloration. On April 6, Dr. Lilienthal removed a specimen for examination, considering the case inoperable. On July 6, in order to relieve suffocative symptoms, Dr. Elsberg, his associate, attempted to extirpate the mass and succeeded in removing about half of it. She left the hospital about three months later, returning the following March with a huge fungating mass. She died the same month of repeated hemorrhages. Dr. Mandelbaum, pathologist to the hospital, examined the original specimen and also the larger portion which had been later excised. His report is hæmangioma arising from perithelium. The cells are uniform, varying but little in size and appearance, thus differing from the usual type of malignant tumor.

57. Lilienthal.[42]—October 8, 1913, before the New York Surgical Society, Dr. Lilienthal presented a case of tumor of the carotid body, with the following report: "This woman was presented by me in the spring of 1909 before this society. At that time she was fifty-six years old, and stated that she had had a small lump in the side of her neck for 30 years. For five years before she had consulted me this had increased considerably in size, and during one year it had grown rapidly, so that

she became alarmed. The diagnosis of tumor of the carotid body was made before the operation because of the hardness, the location, the long history, and because I had had the opportunity to examine a similar case, and afterward to operate on it, some years before. That patient died about two years after the operation of relapse with cachexia, but with no secondary or metastatic growths. The histological diagnosis, as in the present case, was made in the laboratory of Mt. Sinai Hospital. The tumor in my patient to-night was the size of an egg at the time of the first operation. There were firm adhesions to the internal jugular vein and to the carotid artery, so that it was necessary to ligate both of these vessels close to the clavicle, and using them and the freed tumor as tractors it was possible to shell out the pneumogastric nerve and ligate the internal and external carotid arteries and also the jugular vein in their upper portions. The day after the operation there was aphasia and well-marked right hemiplegia. The left eyeball was soft and its pupil contracted. In a few days all symptoms except the contraction of the pupil had disappeared. The pupillary contraction was probably due to injury of the superior cervical sympathetic ganglion. The aphasia was central. There was no aphonia. . . . DaCosta states that the apparent pulsation in these tumors is transmitted from the arteries. In the patient presented here to-night it appears to me that the tumor itself undoubtedly pulsates. I consider the case inoperable, and the patient now shows signs of cachexia."

58. GRAHAM.[43]—A male, age twenty-seven, was admitted to Lakeside Hospital, Cleveland, October 27, 1906, with a tumor on the right side of his neck that had existed for ten years. The tumor, not visible but palpable in its early stages, was free from pain and discomfort, and had been discovered accidentally. There had been severe headaches, the eye had been inflamed and the pupil irregular. During the six weeks previous to admission to the hospital the patient had suffered from sharp, shooting pains radiating to the left ear. At the operation, by Dr. Crile, a tumor 5 x 4 x 3 was removed by ligation of all the carotids. The recurrent laryngeal and the superior cervical sympathetic nerves were divided. The hypoglossal nerve was adherent to the tumor and was deflected from its course. During the operation there had been free bleeding, difficult to control, and at its conclusion the patient was suffering from severe shock. The next day the left pupil was contracted and the left eye paretic, and the patient suffered marked hoarseness. Weakness of the calf muscles and the arm developed after ten days, but recovery was complete. There has been no recurrence to date. Histological examination showed the growth to be a tumor of the carotid body.

59. GRAHAM.[43]—A male, aged twenty-seven, was admitted to the Lakeside Hospital March 12, 1913, with a diagnosis of tumor of the right tonsil. The tumor was known to have been present for seven years, and during that time it had not increased much in size. There was no pain and no difficulty in breathing or swallowing. The growth pushed far into the pharynx, reaching to the uvula. Externally it extended from the ear to the angle of the jaw, was smooth, round, and about the size of a small egg. It was slightly movable from side to side but not up and down. The right submaxillary glands were enlarged. Dr. Crile

removed the tumor, 5.5 x 4.5 x 2.5 centimetres, by ligation of the external carotid artery and internal jugular vein. A portion of the vagus was resected, the hypoglossal nerve laid bare but not injured. After the operation the right pupil was contracted and irregular, and there was marked hoarseness. Both these conditions were present at the time of discharge, one month later. Histological examination showed a typical tumor of the carotid body.

60. Callison and MacKenty.—The case reported in this paper.

Recapitulation.—In the 60 cases of tumor of the carotid body four cases (28, 29, 36, 43) have been found at autopsy. Two (25, 30) were examined post mortem, although the existence of a tumor had been known when death occurred from other cause. The remaining 54 cases have come to operation. In four (41, 54, 56, 60) the tumor was laid bare, only to find such extensive involvement that nothing could be done. All three carotids were ligated in 32 cases, the external only in seven cases. In 15 cases the tumor has been dissected away from all the vessels, or dissected away from the common or internal carotids after ligation of the external. In eight cases recurrence took place, in six of these (5, 7, 14, 24, 37, 39) after the tumor had been dissected away from the blood-vessels, in two cases (38 and 57) after complete removal of all the carotids. In one case examined after death (26) there were metastases in the liver. Of the 54 patients operated on, 42 have recovered and 12 died. But to these twelve deaths must be added four from recurrence and six other speedy deaths in prospect from recurrences known to exist when the case was reported, or 22 deaths in 54 cases. In one other case the patient probably died as a result of the tumor. The causes of death have been: In cases 1, 6, 11, 23, pneumonia, in all of which the pneumogastric was divided or resected at the operation; in cases 3, 32, and 56, hemorrhage; in cases 22 and 41, cerebral anæmia; in case 27, acute œdema of the lungs; case 45, not stated; in case 47, septicæmia; in case 60, infection and hemorrhage.

In addition to this mortality, however, other accidents have arisen in the patients who survived. In cases 2, 12, 26 and 40 the patients have had hemiplegia with aphasia. In four the voice has been affected, and there has been more or less dysphagia. In one there has been such tracheal irritation as to produce a constant cough. In five the tongue has deviated to one side. In four there has been an altered pupil, in one conjunctival injection. In four cases the face has been partly paralyzed.

Etiology.—The etiology of tumors of the carotid body is wrapped in the same obscurity that envelops the causation of other neoplasia. A study of the ages of reported cases seems to offer some justification for von Heinleth's [34] observation that the carotid body reaches full development between 20 and 30, and then either atrophies or goes on to tumor formation. These ages, by decades, are: Up to 20 years, 3 cases; 21 to 30 years, 13; 31 to 40, 12; 41 to 50, 14; 51 to 60, 10; over 61, 5. In three cases the age is not stated. It is thus seen that in 57 cases in which the age is given, 39 occurred between the ages of 20 and 50. This is accentuated by a study of the duration of the cases. In the younger individuals, the duration is short, while in older persons the duration is of much greater length, 17 years in cases 39 and 45. The sexes are equally affected—31 males and 28 females, with the sex not stated in one case.

The Nature of the Growth.—These tumors usually have a long history of slow growth. During this period they may manifest the characteristics of a benign neoplasm. They are encapsulated, do not invade the surrounding tissues, do not return if completely removed, and give rise to no symptoms other than the deformity. Complete removal is, of course, difficult on account of their location. Later they may take on rapid growth and assume the characteristics of a mildly malignant tumor, recurrences and metastases being reported, but the cachexia and anæmia of a malignant growth are not present. Considering this history, and on the histological structure, Beitzke, in his case, and Kocher, in the case reported by Licini, designate the condition as a " struma." Their uniform classification in one of the tumor groups is not possible because of the varying structure of the tumor in some of the cases. They have been most usually diagnosed as endotheliomata or peritheliomata. The structure of the case here reported is more closely allied to the endotheliomata than any other form of tumor. Leithoff,[33] in the case reported by von Heinleth, and Woolley, in his own case, lay stress on the sarcomatous change occurring in the new growth. Alezais and Peyron describe a change in their tumor which seems to be carcinomatous. This is, so far as I have been able to discover, the only recorded case in which apparent epithelial change was present. Cecca reports his case as primary angiosarcoma. Until a more definite determination of their nature has been made, the best term to use in their diagnosis is simply " tumor of the carotid body."

Symptoms.—The symptoms of tumor of the carotid body are both subjective and objective.

Subjective Symptoms.—The patient may present himself at an early stage of the growth, because of the deformity, and desire cosmetic betterment; he may come at a later time, because of fear of the consequences of a rapidly growing tumor of the neck; or he may only present himself for relief from some of the symptoms caused by the progressive damage done by the tumor, as in the case here presented.

In the first case he will complain of no symptoms but the deformity of a tumor of the neck. There is no pain or tenderness, and he only asks for cosmetic improvement.

In the second and third stages the symptoms are due to involvement of the cranial and sympathetic nerves. The number and severity of the symptoms will depend upon the extent to which the tumor has grown. There may be difficulty in phonation or swallowing, or an annoying cough may be present. He may complain of deafness or conjunctivitis. There may be, at a late stage, some pain as nerve trunks are being included in the growth. On the whole, the subjective symptoms are surprisingly few.

Objective Symptoms.—The objective symptoms are more numerous and constant than the subjective. The findings on examination will vary according to the stage at which the patient presents himself. In the early stage there is a tumor from the size of a robin's egg to one that can just be palpated. It is underneath the sternomastoid, or at its anterior margin, on a level with the upper border of the thyroid cartilage. It is egg-shaped, single, discrete, firm, elastic, movable laterally but not vertically. There is a pulsation, transmitted but not expansile. A stethoscope placed over the tumor will reveal a distinct bruit in most cases. As the tumor progresses the picture changes, and more and more structures are involved. Perhaps the most constant of the later symptoms is the paralysis due to involvement of the recurrent laryngeal while its fibres are still within the vagus. These reveal themselves as paralyses of the cords and other laryngeal and pharyngeal muscles, leading to difficult phonation and deglutition. The larynx may be congested and catarrhal. The pupils may be irregular and fail to react to light on the affected side. When the tumor becomes more extensive and invades surrounding structures its mobility may be distinctly less. At this stage the larynx may be pushed to one side, or the tumor may bulge into the pharynx.

Differential Diagnosis.—The first difficulty in the way of making a diagnosis of tumors of the carotid body is their rarity. Were they more common the diagnosis would be comparatively easy. But when one is encountered its true nature is not suspected. Seven have been recognized before operation. These were by Reclus and Chevassu, Kopfstein and Maydl, Da Costa (two), Kocher in the case reported by Licini, Boni, and by Lilienthal in his second case. Kuznetsoff narrowed his tumor to a lymph adenitis or a tumor of the carotid body. Keen thinks he would recognize another one if it should come under his observation.

Tumors of the carotid body must be differentiated from cervical lymph adenitis, early metastatic carcinoma of the lymph glands, sarcoma, particularly lymphosarcoma and sarcoma of the lymph glands, lipoma, fibroma, aneurism, branchial cyst, gumma, Hodgkin's disease, aberrant thyroid and Bezold's perforation of the mastoid. It is only when these conditions occur in the superior carotid triangle that a differentiation must be made.

Cervical lymph adenitis is usually multiple, and as a rule these nodes invade the surrounding tissues and are matted together. They may be tender. Reclus says they are entirely hard or entirely soft. If the nodes attach themselves directly to the large arteries of the neck, and are very hard, there may be a transmitted pulsation. Finally, the history, with the subcutaneous tuberculin test, with its associated rise of temperature and aggravation of the local picture, may decide their nature.

In carcinoma the primary focus can usually be located, the nodes are usually multiple, are rapidly growing, of stony hardness, and later there will be increasing cachexia and anæmia. Carcinoma usually invades the surrounding tissues, so that motion in all directions is limited.

Sarcoma is rarely limited to one lymph node, but several closely connected glands will be involved. There is movement in all directions in the early stages, and no transmitted pulsation. Pulsation and murmur rule out lymphosarcoma, according to Kopfstein.

Fibromas are more superficial, harder, and more movable than carotid tumors, and are rarely found in this location. Should one occur, however, its differentiation would be difficult.

Lipomas have a woolly feel, are softer, more superficial and less uniform. They lack the pulsation of a carotid tumor, and are movable in all directions.

Branchial cysts are usually superficial, but they may reach to the deep structures of the neck. As a rule they are congenital. Fluctuation is usually present. After being satisfied that the condition is not an aneurism, aspiration will demonstrate the nature of a cyst, as either a light colored or cloudy fluid will be obtained.

Hodgkin's disease gives multiple nodes, movable, and is bilateral from the first. In density they are intermediate between malignant tumors and tuberculous glands. The nodes feel like lipoma, but are more deeply situated.

Syphilis of the glands gives an adherent, hard, matted mass, and there is usually other evidence of syphilis. The Wassermann and Noguchi reactions will aid in the diagnosis, when positive, or a therapeutic test may establish the nature of the swelling.

Aneurism gives rise to an expansile pulsation, the pulse on the affected side is delayed in the temporal arteries, and there is a gurgling murmur over the tumor.

Kopfstein excludes aberrant thyroid by the absence of an enlarged thyroid gland. Reclus says he has never seen aberrant thyroid gland as high as the thyroid cartilage.

The differential diagnosis, hard as it is on paper, is yet more difficult in actual practice. After the surgeon has exhausted every diagnostic means at his command, he will still be in doubt as to the nature of the tumor he is considering. It then becomes necessary to remove a fragment of tissue for pathological diagnosis, or to proceed in ignorance of the nature of the growth with which he is dealing.

Surgery.—The detailed surgical treatment of tumors of the carotid body is beyond the proper bounds of this paper. Yet some suggestions from a pathological viewpoint may not be amiss. The history of this tumor shows it to be, in its early stages, a benign tumor, which later takes on a malignant growth. The surgical treatment, therefore, for purposes of consideration, can be divided into two cases. A diagnosis is rarely made in the early, benign stage, but an operation is attempted under some mistaken diagnosis, and then the true nature of the tumor is discovered. If now the tumor is not closely adherent to the arteries, except through the "ligament of Mayer," it seems safe to dissect it away from the bifurcation. Keen advises against this, but I can see no objection if a close watch is kept for recurrence and then such further operative procedures taken as the case may demand. On the other hand, if the tumor surrounds the arteries, is closely adherent to the wall, and other structures are included in the surface of the growth, then an attempt to dissect away the mass must be condemned. Five recurrences out of fifteen in which this has been attempted argue strongly against it.

The surgeon may now close up the wound, leaving the tumor *in situ,* as Green did; or he may remove the tumor and arteries together, the usual course pursued. This involves ligation of the common, internal and external carotid arteries, also probable ligation of the internal jugular vein, and the attendant danger of injuring the pneumogastric, hypoglossal and other nerves. The surgery now changes from that of a tumor of the carotid body to that of the carotid artery. As this is one of the most formidable and dangerous operations the surgeon is called upon to perform, each must decide for himself the course to be pursued.

In closing I wish to thank Drs. Mathews, Lilienthal, and Coley for the personal cases they have given me; Prof. Ewing for his suggestions as to the nature of the tumor; Dr. H. T. Brooks for suggestions in the preparation of the paper, and Mr. Wm. S. Dunn, of the Photographic Department of Cornell University Medical College, for furnishing the microphotograph used in the illustration.

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THE EARLY DIAGNOSIS OF HYDRONEPHROSIS BY PYELOGRAPHY AND OTHER MEANS.

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In dealing with a new and unfamiliar method of diagnosis such as pyelography it is not unreasonable to ask where the necessity for its use arises. To meet this question I shall preface my remarks by a short account of our means of diagnosis of hydronephrosis, and their practical value. Hydronephrosis, as we know it clinically, presents two stages in its development. There is a stage during which symptoms alone are present and a stage where a swelling is constantly or intermittently found in the loin.

I take it that when a large permanent swelling is present there can seldom be any remarkable difficulty in making a diagnosis, first, of a renal tumor and then of the hydronephrotic nature of the tumor, none at least which is not generally recognized and the salient points in the differential diagnosis of which are not worn threadbare by constant repetition. Diagnosis in this, the second stage, need not therefore concern us here.

Two questions do, however, arise in regard to this second stage of hydronephrosis, which have a very direct bearing on our subject. In the first place what amount of damage has the kidney sustained? In other words, what is the value of a hydronephrotic kidney? And second, if the obstruction is relieved will the kidney return to its normal state? Space does not permit of full discussion of these important questions, only the briefest reference to them is possible.

1. In the fully developed hydronephrosis the wall of the sac is reduced to half or one-quarter of an inch in thickness. In this the renal tissue is spread out over a large area and there is an advanced degree of interstitial nephritis.

The functional value of such a kidney is greatly impaired. The percentage of urea is diminished. The following is the result of 8 examinations made in a case of movable hydronephrotic kidney:

Left kidney (hydronephrotic).	Right kidney (healthy).
Urea 0.45 per cent.	Urea 1.4 per cent.
Urea 0.55 per cent.	Urea 1.5 per cent.
Urea 0.68 per cent.	Urea 0.93 per cent.
Urea 0.45 per cent.	Urea 0.89 per cent.
Urea 0.49 per cent.	Urea 0.9 per cent.
Urea 0.5 per cent.	Urea 1.0 per cent.
Urea 0.6 per cent.	Urea 1.0 per cent.
Urea 0.55 per cent.	Urea 1.0 per cent.

Variations in the elimination of sodium chloride and phosphates follow those of urea. The methylene blue test shows a corresponding reduction in the functional power as the following observations show:

Healthy kidney.	Hydronephrotic kidney.
Elimination of blue:	
Commenced fifteen minutes.	Commenced three hours.
Quantity satisfactory.	Quantity very small.
Duration 4 days.	Duration 3 days.
Elimination of chromogen:	
Commenced fifteen minutes.	Commenced six hours.
Quantity satisfactory.	Quantity greater than blue.
Duration two days.	Duration three days.

Significant figures are also obtained by the use of phloridzin. In a case of calculous hydronephrosis the injection of 5 mg. phloridzin gave the following result:

Right healthy kidney.	Left hydronephrotic kidney.
Sugar, .510 gramme.	Trace.

In a case of bilateral hydronephrosis the intramuscular injection of 5 mg. of phenol-sulphone-phthalein was followed by staining of the urine in 29 minutes. The left kidney was completely blocked and no urine passed, the urine from the right kidney showed a percentage of the coloring material of 3.25 during the first hour and 2.25 during the second hour instead of 40 to 60 per cent. during the first hour and 20 to 25 per cent. in the second hour observed in the normal individual.

But although the function of these kidneys is greatly impaired they are not worthless. I shall later describe a case (Case VI) in which I operated for the relief of advanced hydronephrosis in both kidneys and the patient is well and doing a full day's work two years after the second operation and probably much longer after the development of the bilateral hydronephrosis. What remains of the renal tissue in his case has been saved but there is just sufficient to carry on the renal functions and at any time this may fail.

2. After the relief of obstruction, either temporary by natural means in an intermittent hydronephrosis or permanent by operative interference, the kidney does not return to its normal state.

The following case of bilateral hydronephrosis illustrates the gradual decline in the functional powers of the kidneys in spite of successful relief of the obstruction.

CASE I.—Mrs. D., aged thirty, first noticed a swelling in the right side of the abdomen twelve months ago, two months after the birth of her only child. Pregnancy and the puerperium had been normal. There was dragging pain in the loin followed by appearance of the swelling and vomiting. The attack lasted about twelve hours, and then the swelling subsided and a large quantity of urine was discharged. There had been twelve such attacks. There was nocturnal frequency but no other urinary symptoms. On examination there was a large fairly tense movable hydronephrosis on the right side extending as low as the pubic symphysis. A vertical groove indicated the division between the distended renal pelvis and kidney. The left kidney was not palpable. The bladder was healthy, the right ureteric orifice small and surrounded by a blush of congestion. The orifice contracts at regular intervals and emits a copious clear efflux. Left ureter larger and normal in appearance and shows regular contraction and a clear efflux. A No. 7 F. ureteric catheter passed up the right ureter for sixteen inches without meeting obstruction and a constant stream of clear urine flowed from it under considerable pressure which could be increased by pressure upon the hydronephrosis. In half an hour 13 ounces of clear urine were withdrawn, the hydronephrosis was reduced to a flat, freely movable mass and the urine issued from the catheter in slowly intermittent drops. An intramuscular injection of phenol-sulphone-phthalein was made after catheterization of the second ureter. No urine escaped from the catheter in the left ureter during the whole of the test. The urine from the right kidney became colored in 29 minutes. During the first hour only 3.25 per cent. and during the second hour a similar percentage of the coloring material was obtained. On the following morning a hydronephrotic swelling was found on the left side of the abdomen. This was slightly smaller than that on the right side.

On July 16 the following operation was performed on the right kidney: (1) The kidney was exposed and dislocated from the wound. The ureter was found bound down to the surface of the greatly distended pelvis by fine adhesions and was dissected up to its insertion into the pelvis. A large flap of fibro-fatty tissue covering the posterior surface of the greatly distended pelvis was turned back. A triangular area, the size of the palm of the hand with the apex toward the ureteropelvic junction, comprising nearly the whole of the posterior wall of the pelvis was removed. The pelvic ureteral junction was narrow and the incision was carried down through this into the ureter and this part of the incision stitched transversely. The edges of the pelvic wound were brought together by a series of interrupted catgut sutures and the line of suture was covered by the flap of fibro-fatty tissue. The capsule was stripped from the posterior surface of the kidney and the organ fixed by catgut sutures to the posterior abdominal wall. Blood appeared in the urine for three days and then the urine became clear. Healing was aseptic.

The left kidney continued painful and distended. Three weeks after the operation the right kidney was not enlarged or tender but the left kidney was large, tense and painful. Cystoscopy showed a copious clear efflux from the right ureteric orifice. The left ureteric orifice was widely open and showed an occasional feeble contraction without efflux.

A ureteric catheter passed for 12 inches and was then arrested. It passed on after a little manipulation and urine flowed. On August 9 a plastic operation similar to that done on the right kidney was performed on the left kidney. The contents of the kidney were turbid and there were six small facetted black stones. A ureteral catheter was passed through an incision in the convex border of the kidney across the cavity of the pelvis and down the ureter for two inches. A rubber tube was placed alongside this to drain the pelvic cavity and another in the perirenal tissues. The ureteric catheter was removed at the end of a week and the tube a few days later and the wound healed. The temperature rose a week after the operation and fell to normal after a week. The patient began to lose flesh about the time of the second operation and this gradually progressed until she became emaciated. There was thirst and dry tongue, anorexia and headache and the urine had a specific gravity of 1007. The quantity of urine varied from 30 to 48 ounces. A month after the second operation the symptoms of renal failure gradually increased. The temperature which had been normal became subnormal and the quantity of urine diminished to 28 and then to 18 ounces. She died six weeks after the second operation of renal failure.

There must be a time, I admit, in the early stage of hydronephrosis when permanent relief of obstruction will be followed by complete restoration of the kidney to its former condition. But this time is at the very commencement of the dilatation. It is long past when the kidney can be felt enlarged on palpation of the abdomen.

The damage produced by obstruction in fully developed hydronephrosis is permanent. I shall later show proof of this in several cases (notably Case VI) examined after removal of the obstruction.

From the foregoing it will, I think, be admitted that a diagnosis must be made in the first stage of hydronephrosis, so that operation may be undertaken before permanent damage has been done to the kidney. I shall therefore discuss briefly the diagnosis in this stage, that is, in the stage of commencing dilatation of the kidney when the organ is not yet recognized as being enlarged on palpation of the abdomen.

There are two well-defined clinical groups of cases. In one group some recognized cause of hydronephrosis such as calculus or movable kidney is discovered on clinical examination and in the second group no condition which might cause hydronephrosis is found clinically. The obstruction in the latter group is due to congenital stenosis or valves of the ureteropelvic junction or to the pressure of aberrant renal vessels.

1. I shall take the simple stone cases first. The diagnosis of stone in the pelvis of the kidney or impacted in the ureter does not come within the province of this article. I wish to take a step further.

Let us suppose that the diagnosis of stone at the upper end of the ureter or of stone impacted in the ureter is made by symptoms and by the X-rays. The question will at once arise, "Is the presence of the stone causing damage to the kidney?" It might do so in two ways, either by being the predisposing cause of infection or by causing dilatation of the ureter, pelvis and kidney. This question has a very important bearing on our decision in regard to immediate operation.

Few surgeons will, I think, state that every calculus which is recently impacted in the ureter must at once be removed. In my experience over 50 per cent. of calculi found in the ureter are passed into the bladder and discharged with the urine. There are calculi which from their large size or oval, round, or elongated contour, as shown by the X-rays, we know cannot pass and must be removed by operation. To these I need not further refer. But there is a larger class of cases where a small oval calculus has recently become impacted in the ureter. By energetic diuretic treatment supplemented sometimes by a visit to a suitable watering-place, a large number of such calculi pass and no surgical operation is required. In others this treatment fails, obstruction commences gradually and the ureter and kidney become dilated. At what period must we say that diuretic treatment has failed and operation is imperative? Undoubtedly as I have already insisted, in the earliest stage of dilatation, before permanent damage has resulted.

What now are the signs of commencing dilatation of the kidney in a case of ureteric calculus? Pain has been present in the form of renal colic. There may have been a single attack and no more, but usually there are repeated attacks at irregular intervals depending upon exercise or the taking of diuretics, medicinal or dietetic, or upon other causes. As time passes these attacks become less frequent and in the absence of pain the patient becomes more reconciled to the presence of the calculus in his ureter and less inclined to accept the suggestion of an operation. This prolongation of the intervals of colic with diminution in the severity of the attack and eventual reduction to an occasional ache is, I hold, significant of a dilating ureter and renal pelvis. I shall later show that the renal pelvis becomes less and less sensitive as it dilates until a period is reached when even comparatively powerful distention does not give rise to pain. And, moreover, the muscular tissue of the pelvis and ureter are progressively destroyed so that the muscular spasm which constitutes renal colic becomes less and less violent. The gradual disappearance of colic is therefore an important sign of dilatation, but when it has become apparent the dilatation is already well advanced and permanent damage has been done to the ureter and kidney.

Constant aching may be present in the kidney and is a sign of commencing dilatation. It is, however, often absent and when present may be due to other causes.

Persistent polyuria is a significant symptom when it exists, but it is readily overlooked and when noted may be regarded as a sign of chronic Bright's disease rather than of a dilating kidney on one side. The following case is so interesting in this connection that I venture to insert it here:

Case II.—W. R. W., a well built man of thirty-eight, was referred to me by Dr. A. J. Whiting, complaining of pain in the left flank and "deterioration of health." Two years previously he had pain in the left loin and albumin was discovered in the urine. The albumin diminished with rest and treatment. Nine months after the first attack of pain there was a second, and similar attacks have recurred at intervals of some months since that time. He suffered from headache, giddiness and nausea. The urine was acid, specific gravity 1006 and contained albumin which varied from a haze to 175 per mg. The quantity varied from 120 to 165 ounces in 24 hours. Casts, blood or pus have never been found in the urine. A small round calculus was shown by the X-rays in the left ureter just outside the bladder. The ureteric orifice was surrounded by thickened, deep red, wrinkled mucous membrane.

In consultation, the late Sir William Allchin held that chronic interstitial nephritis was present in addition to the stone and was the cause of the polyuria although the absence of cardiovascular changes was remarkable. The stone was removed extraperitoneally and the ureter was found dilated to the size of the little finger. Convalescence was uninterrupted. The sequel was striking and I am indebted to Dr. A. R. Whiting for a most painstaking examination of the urine. The quantity of urine fell to an average of between 40 to 50 ounces in 24 hours with a specific gravity varying from 1010 to 1024 and urea from 6 to 7 grains per ounce. In two months the albumin had completely disappeared.

It will be seen that the symptoms of gradual dilatation of the kidney in ureteric calculus are few and variable and until dilatation has become fully established a diagnosis cannot be made. Similar difficulties exist in regard to the early diagnosis of hydronephrosis resulting from abnormal mobility of the kidney.

2. I shall now refer to the second class of cases where no obvious cause of obstruction is discovered clinically and at operation the block is found to be due to congenital stenosis or valve formation at the ureteropelvic junction, or to the pressure of an aberrant renal artery. The symptoms that may precede the appearance of a tumor in the loin in these cases are pain and intermittent polyuria. Two well-defined types of pain are observed. In one there is constant dull aching which may be worse on movement or on lifting weights. The following case illustrates this type:

Case III.—G. J., a warehouseman, aged forty-two, came under my observation at St. Peter's Hospital in July, 1906. He had suffered for eight years from dull aching pain in the right side of the abdomen extending round to the back. He had been examined at St. Peter's Hospital when the pain first began but nothing was found. The pain gradually subsided and he felt little of it for 4 or 5 years and then it appeared again and gradually increased for 3 years. The pain was worse after muscular exertion and better after rest. For six years he had been subject to attacks of vomiting and for over a year had been treated at a large general hospital for dyspepsia. The urine had not shown any abnormality in quantity or appearance.

In July, 1906, I found a large elastic renal tumor on the right side. An X-ray examination was negative. The right ureteric orifice was thick-lipped, elongated and motionless. A bougie opaque to the X-rays passed up the ureter to the transverse process of the third lumbar vertebra. No urine was obtained by ureteric catheter on the right side. On operating I found a large thin-walled hydronephrotic sac with stenosis at the ureteropelvic junction and performed nephrectomy.

The second type of pain in commencing hydronephrosis occurs in severe intermittent attacks of colic occurring without other symptoms.

The following is an example of such a case when obstruction was due to an aberrant renal artery and vein.

Case IV.—W. D., a boy aged thirteen, complained of attacks of pain in the left loin during the past eighteen months. The pain was severe and was usually accompanied by vomiting. It did not radiate. There was aching afterward but the boy was quite well in the interval. The attacks came on once a week on Saturday. Friday was a holiday and was spent in playing outdoor games. There had been no hæmaturia and no sudden variation in the quantity of urine. I examined him after the pain had been going on for about a year but could find nothing abnormal and the X-ray examination was negative to stone. Six months later I again examined him. The lower pole of both kidneys was palpable but no enlargement could be detected and there was no tenderness. On operation I found a lobulated, slightly enlarged kidney with a large distended pelvis. The ureter was normal in size and appearance. Crossing the ureteropelvic junction there was a band of fibrous tissue containing a large artery and vein passing to and from the anterior surface of the lower pole of the kidney. The point of obstruction of the ureter was situated at the crossing of the vessels. The vessels were ligatured and divided and the pelvis opened and examined. No obstruction remained after cutting the vascular band. The lower pole of the kidney became blanched and remained pale for about a quarter of an hour when it gradually assumed a deep red color.

Constant aching pain in the renal region may arise from many conditions other than early hydronephrosis. I have seen it in osteo-arthritis of the vertebræ and this subject has been referred to in an excellent article by Dr. Chute of Boston.[2] There are also bowel pains, duodenal or colon, and gall-bladder pains which lie so near to the kidney area as to make confusion possible. But apart from extrarenal causes of pain there are many conditions which may give rise to pain in the kidney even when the common surgical causes such as stone, tuberculosis and growths are excluded. Unilateral renal aching may occur in slight pyelitis, interstitial nephritis, phosphaturia, and oxaluria. It is not possible to submit every case of renal aching to operation, but short of this a diagnosis of commencing hydronephrosis cannot be made from pain alone.

Acute attacks of renal pain are more likely to lead to a diagnosis, but even here, attacks of vomiting or other collateral symptoms are likely to lead the surgeon astray when the lower pole of the kidney can be felt normal in size. Intermittent polyuria is an unreliable symptom. Time and again I have received a clear account of this symptom and found no dilatation of the kidney at operation. Two examples of this will be described later (Cases VIII and IX).

Intermittent hysterical polyuria is common and when this is combined with abdominal pain nothing appears to be wanting in the history of an intermittent hydronephrosis, especially when the kidney is unduly movable.

In the foregoing remarks I have endeavored to show that a diagnosis of dilatation of the kidney is seldom if ever made before a palpable tumor appears in the loin and that when the hydronephrosis has reached this stage there is extensive damage to the kidney which is permanent.

I shall pass now to the methods by which a diagnosis of dilatation of the kidney can be made in its earliest stage.

THE X-RAYS AND URETERAL CATHETER IN DIAGNOSIS OF HYDRONEPHROSIS.

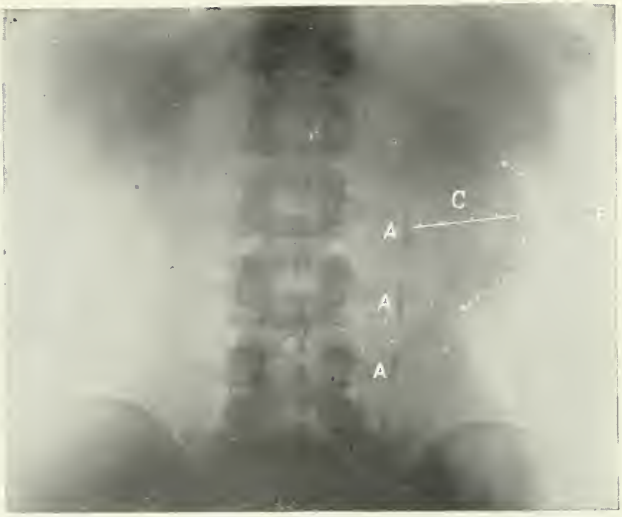
(*a*) *The outline of the kidney shown by the X-rays.* When the dilated kidney is of large size there is little difficulty in recognizing its dimensions by means of the X-rays. In some cases the great extent of the shadow may tend to obscure the reading of the radiographic plate. The upper pole is under cover of the ribs while the lower is hidden by the shadow of the iliac crest. When calculi are present as they were in Case VI they frequently mark the lower limit of the hydronephrotic kidney and may also show the position of the obstruction at the pelvis of the kidney.

The great extent of the renal shadow will thus be more readily grasped and the reading of the plate become plainer. When the hydronephrosis is of medium size there will be less difficulty in recognizing a renal shadow for the lower limit lies within the clear loin area. There is more difficulty in detecting slight enlargements of the kidney shadow.

An experienced radiographer can show the outline of the kidney even in stout subjects. If a fixed position is used and the kidney is not displaced, the shadow will bear a constant relation to the vertebræ, ribs, and psoas muscle. There is, however, no standard size for the kidney, which will fit all patients. The normal kidney varies in size in men and women and also in different individuals so that slight variations in the extent of the shadow cannot be accepted without further proof, as indicating enlargement of the organ. Apart from that, the varying size of the body makes it impossible to give the kidney the same relation to the plate in each, and unless this can be ensured, uniformity of size of the shadow cannot be obtained. The relation of the kidney shadow to the twelfth rib gives no help, for this rib varies very greatly in length and in the angle it forms with the vertebræ, not only in different individuals but also on each side in the same individual.

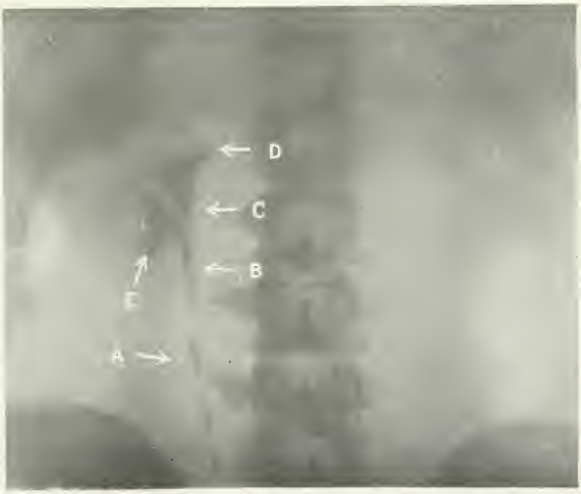
(*b*) *Proportional renal mensuration.* With the object of obtaining some method of measurement which will be un-

Fig. 1.



Measurement of the kidney shadow. *A*, *A*, *A*, opaque segments (½ inch) of catheter; *B*, points at margin of kidney shadow; *C*, measuring line, in half inches, across kidney shadow.

Fig. 2.



C, dichotomous pelvis, not dilated; *D*, *E*, calyces; *B*, junction of ureter and pelvis. *A*, opaque catheter in ureter.

affected by the size of the individual and the distance of the kidney from this plate I have used the shadow thrown by the vertebral bodies in the individual under examination as a means of measuring the size of the kidney. The variation in the breadth of the vertebral bodies appears to run parallel with the variation in size of the normal kidney and, presuming that the kidney is not displaced, a fact that is easily ascertained, the method is a sufficiently accurate guide for routine examination. It is as follows:

If the narrowest transverse measurement of the shadow thrown by the first lumbar vertebra be taken and this measurement doubled and projected transversely from the outer edge of the vertebral body at its middle, a point will be found. If the same measurement be made in regard to the second and third lumbar vertebræ two other points will be obtained. By joining these three points the outer border of the normal kidney is roughly indicated. Any increase beyond this line may be regarded as abnormal.

Further I have found it possible to measure the size of the kidney and to express the measurement in inches or fractions of an inch in the following manner. My ureteric catheters are made with an alternate opaque and translucent band each of which is half an inch. If one of these catheters be passed up the ureter to the kidney the opaque and translucent bands will show in the same plane as the kidney and the relative shadow value of half an inch is obtained. By marking a piece of paper in half inch values and laying it across the kidney shadow the actual size of the kidney is found (Fig. 1). Anatomically there is a slight difference between the X-ray shadow of the kidney and the actual breadth of the organ. The kidney does not lie absolutely flat, for the hilum is tilted slightly forward so that the shadow is narrowed to an insignificant extent.

An increase in size in the outline of the kidney indicates that dilatation has already taken place.

(*c*) *Kelly's method of estimating the capacity of the renal pelvis.* A ureteral catheter is passed so that the eye enters the renal pelvis. The urine is allowed to run off and warm boracic solution or saline solution is slowly injected into the renal pelvis by means of a syringe. When the pelvis is full the tension causes pain in the kidney. The quantity which has been injected is now noted and is taken as the capacity of the renal pelvis. If the injection be stopped the pain passes off quickly as the fluid drops away from the ureteric catheter. If the fluid is too cold or if it is injected too quickly, spasm of the renal pelvis is set up and pain occurs before the pelvis is full. A capacity of 30 to 40 c.c. represents a slight degree of hydronephrosis. According to Braasch[3] if 150 c.c. can be injected but little secreting tissue remains.

In practice there are certain difficulties and fallacies in this method. There are at present very divergent views as to the normal capacity of the renal pelvis. Luys states the normal capacity as 2 to 3 c.c. Braasch found the renal pelvis post mortem had a cubic content of 2 to 5 c.c. whereas in the living it will often hold 20 c.c. or more, while Bazy looks upon a pelvis which contains 30 to 35 c.c. as normal. In my own cases checked by pyelography or operation the normal pelvis did not exceed 5 or 7 c.c. in capacity and was usually less. Until we can obtain more extensive observations on the capacity of the healthy pelvis, the earlier stages of dilatation are likely to be overlooked by this method.

Another fallacy is the escape of some fluid along the ureter outside the catheter. By placing a catheter in the urethra and coloring the injection fluid with methylene blue any escape will be detected by the urine draining from the bladder being tinged with blue, but the amount cannot be measured, as it will be blended with the urine from the other kidney.

Still another fallacy appears to me to arise in making these observations. A kidney working under raised pressure, as these slightly hydronephrotic kidneys are, usually shows polyuria. With a fine-bore catheter, such as we use for the ureter, it is difficult to empty the pelvis completely when an abundant polyuria is in progress, and it is certain that while the boric lotion is being slowly injected the kidney is rapidly secreting urine. The distention of the pelvis is thus due, not only to the artificial injection but also to the urine. I believe therefore that the capacity of the pelvis is frequently underestimated by this method.

(*d*) *Pyelography.* By this method, introduced by Voelcker and Lichtenberg, a diagnosis of dilatation of the kidney pelvis and calyces can be made before the outline of the organ is increased in size.

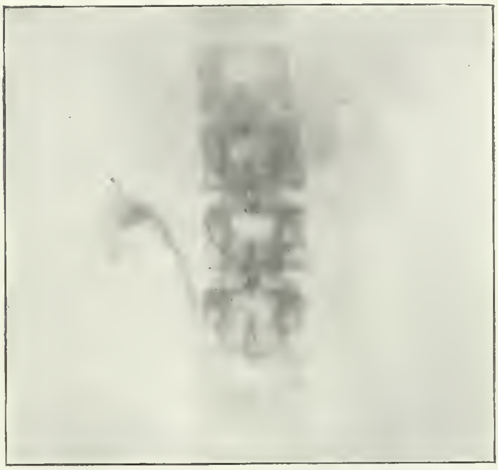
Pyelography consists in filling the pelvis of the kidney with an innocuous fluid opaque to the X-rays and obtaining a radiogram. The method of pyelography has been fully described elsewhere and only the salient points need be repeated. A catheter is passed up the ureter so that the eye enters the renal pelvis and the contents are allowed to run off. The bladder is emptied and the cystoscope removed leaving the ureteric catheter in position. The collargol solution is heated and slowly introduced. I use either a solution of 10 per cent. or 20 per cent. and introduce it by means of an all-glass syringe of 20 c.c. capacity. A blunt hollow needle is used and fits into the catheter and a fine plug should be provided to fit the catheter after the injection is complete. The fluid is introduced by hydrostatic pressure aided by an occasional touch of the finger and of the piston. The barrel of the syringe filled with solution and with the piston in place is attached to the catheter by means of the needle and held as high as the free end of the ureteral catheter will allow. This is about a foot above the level of the body. The quantity introduced varies with the capacity of the pelvis; 40 c.c. or more may be required in a dilated kidney. The patient gives the signal to stop when he feels pain in the pelvis of the kidney. The syringe is then removed and the end of the ureteral catheter plugged and the radiographer proceeds without delay with his photography. The value of the radiogram is much enhanced by the use of an opaque catheter which shows the line of the ureter and the angle of the ureteropelvic junction. When the radiogram has been taken the plug is removed from the catheter and the fluid allowed to syphon off. The catheter is removed at the end of ten minutes.

In normal individuals the amount of pain varies. Some have pain only at the time of full distention of the pelvis, others have a dull aching for several hours. In one case, that of a very nervous woman, there was a complete absence of pain at the time of full distention of the pelvis, but a feeling of rawness in the pelvis and ureter the next day. There was no dilatation of the pelvis in this case. In another case of commencing dilatation when the pelvis held 18 c.c. of collargol solution there was no discomfort until two hours later and *this* quickly passed off.

In some cases a severe attack of renal colic follows the examination. It is very important to avoid this during the radiographic exposure as, apart from the inconvenience to the patient, the tense rigid muscles obstruct the passage of the X-rays and this, together with the movement of the patient and the arching of the back which interfere with the action of a compressor, all militate against the production of a sharply defined shadow. The colic may be due to several factors: too rapid filling of the pelvis, too great pressure in injecting the fluid and thus causing over-distention of the pelvis, too cold or too hot solution of collargol are all contributory causes. These points should therefore receive the most careful and detailed attention and the introduction of the fluid should at once be stopped when the sensation of tension in the renal pelvis commences. I have abandoned the practice of giving a hypodermic injection of morphia before the operation as I believe the sensations of the patient are an important guide in the operation. What can we learn by this method?

1. *Is dilatation present?* It is possible during the introduction of the collargol to say with tolerable certainty whether dilatation is absent or whether advanced dilatation is present. When the pelvis is not dilated the flow of collargol is slow, the patient soon feels pain in the kidney and the quantity that enters is small. The greater the extent to which dilatation has developed, the less sensitive does the pelvis become. I have

FIG. 3.



Normal funnel-shaped pelvis with calyces. Point of opaque catheter in upper calyx.

FIG. 4.

Kinking of the ureteropelvic junction and commencing hydronephrosis in lateral scoliosis.

already referred to this insensitiveness of the dilated renal pelvis as an important point in clinical diagnosis apart from pyelography. Pain appears late and is moderate and may amount merely to a dull ache. The fluid enters rapidly and in quantity.

The outflow of collargol after the examination also varies. The non-dilated pelvis with its healthy muscular wall rapidly gets rid of the collargol and the urine is clear in 24 hours or even in 12 hours. In one case the urine was stained only the first micturition after the examination. In the dilated kidney the urine remains stained for several days or a week or even longer.

On examining a number of plates it will be seen that there are two chief types of normal pelvis. In one, the dichotomous pelvis (Fig. 2), the upper end of the ureter splits into two branches without any dilatation and from these branches the calyces arise. In the second form of pelvis the ureter expands into a funnel-shaped pelvis (Fig. 3) from which primary branches project and on these are set the calyces.

When dilatation commences the calyces become clubbed and then elongated so that in a kidney, the seat of moderate distention, the calyces are seen as long processes with rounded ends penetrating deeply into the shadow thrown by the renal substance, and eventually reaching the surface of the kidney. They are well seen in Fig. 6 where the outline of the kidney is clearly defined and the opaque clubbed calyces extend to the limits of the renal shadow. At this stage the true pelvis of the kidney is not necessarily much dilated. In Fig. 6 it does not appear to be dilated at all. This is the " renal " type of hydronephrosis, the final stage of which is seen in Fig. 8. In this case of advanced hydronephrosis the fibrous septa remaining between the pockets of the hydronephrosis, which were originally the calyces, could be detected as clear lines cutting into the opaque block of the collargol filled kidney (Fig. 8).

In the " pelvic " type of hydronephrosis the funnel-shaped pelvis becomes more and more globular. As dilatation proceeds the calyces become broader and shorter and approach each other and they gradually become drawn into the renal pelvis until they have completely disappeared. In this type of hydronephrosis the collargol shadow shows a large uniformly opaque globular shadow on the surface of which small bosses may project (Fig. 11).

An important factor in the production of certain forms of hydronephrosis is some variation in the angle of union of the renal pelvis and ureter. I find that information in regard to the contour of this junction can be obtained by pyelography. In the normal individual the ureter passes up alongside the bodies of the lumbar vertebræ crossing the transverse processes of the fifth and fourth lumbar vertebræ and the tip of the transverse process of the third lumbar vertebra. Its axis is then continued directly into that of the pelvis of the kidney. This can be demonstrated by pyelography with an opaque catheter in the ureter. The line which this catheter takes in the normal individual is either quite straight or has a gentle curve outward commencing at the level of the third lumbar vertebra. A kink of this ureteropelvic junction is shown by pyelography in Fig. 10, a case of movable kidney which has been anchored in a faulty position. In another case of lateral curvature of the lumbar vertebra a very marked distortion of the ureteropelvic junction with irregular dilatation of the calyces is seen (Fig. 4). Further information may also be obtained.

An opaque flexible catheter or bougie passed up the ureter into the kidney pelvis enters the upper calyx of the kidney in the normally placed non-dilated organ. This is seen in Fig. 3 where the renal pelvis and calyces are filled with collargol and throw a sharp shadow. The catheter shadow is denser than that of the collargol and the point is seen lying in the upper calyx. When, however, the kidney is displaced downward or the pelvis dilated the catheter does not enter the calyx but impinges on the upper wall of the pelvis pushing it up like the pole of a tent (Fig. 11).

Another point of extreme interest which is seen in examining plates showing the collargol filled pelvis and calyces with an opaque catheter in the ureter is the variation in the angle formed by the ureter and outer and lower margin of the pelvis with the inner margin of the shadow by the lowest calyx.

This pelvocalycine angle is a widely open angle with a rounded apex in the normal state (see Figs. 3 and 9). When the calyces of the kidney begin to dilate in early hydronephrosis this angle is reduced in size and as dilatation proceeds the shadow thrown by the lower calyx approaches that of the ureter until the angle becomes acute and the space between the shadows is reduced to a narrow vertical slit (Fig. 6). A similar change takes place when the hydronephrosis is of the " pelvic " type. Here the angle between the lower margin of the distended pelvis and the ureter becomes acute (Fig. 11).

It is possible that a similar change takes place in cases of movable kidney when the movement is of the " cinder sifting " type but I have not had an opportunity of demonstrating this.

2. *What is the position of the obstruction?* The presence of a stone in the renal pelvis or ureter will indicate the position of the obstruction. When no stone is present the collargol shadow may render assistance.

When the obstruction is at the ureteropelvic junction the shadow stops short abruptly at the pelvic outlet but when the obstruction is low down in the ureter it tails off as it passes down the ureter. Where the ureter is dilated a shadow of the collargol filled tube may be obtained, as Braasch has shown. In a case where the obstruction was due to a movable kidney I was able after nephropexy to show the dilated pelvis and the collargol passing down the ureter in waves, demonstrating the absence of obstruction and the contractile power of the ureter (Fig. 11). The presence of an opaque segment of the catheter (1 centimetre long) in the clear area of ureteral contraction showed the length of this wave of ureteral contraction to be about 2 centimetres.

3. *Is an abdominal tumor a hydronephrosis or is it unconnected with the kidney?* An abdominal tumor may in its

position, shape, and movements closely resemble an enlarged kidney, the history may give no clue to its origin and there are no changes in the urine and no symptoms pointing to disease of other organs to indicate the nature of the tumor. In such a case the collargol method gives invaluable information.

In Case XIII there was an abdominal tumor which had the shape and position of a kidney and which had been diagnosed as a hydronephrosis by a surgeon of large experience. Pyelography showed that the renal pelvis and calyces were normal in size and outline and were situated some distance above the swelling. Operation demonstrated a mass of hydatid cysts attached to the under surface of the liver.

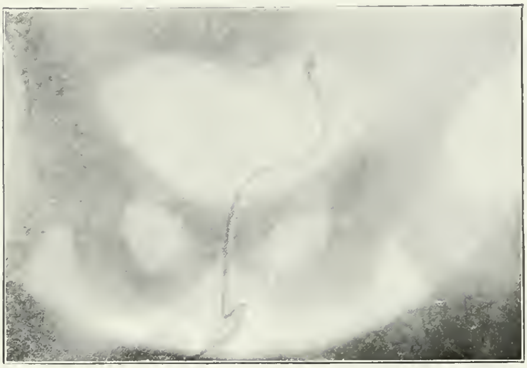
Two other cases operated on in succession on the same day may be quoted in illustration of the use of this method. Both patients were women. In the first there had been attacks of pain in the right side of the abdomen, an indefinite history of an attack of hæmaturia and a doubtful history of jaundice lasting two or three days. There was a large rounded swelling in the right lumbar region which in many respects resembled an enlarged kidney. Collargol injection showed the pelvis and calyces of the right kidney normal and situated high up beneath the ribs. Operation showed the right lobe of the liver dragged down and with its edge concealed by adherent bowel and a gall-bladder full of gall-stones.

In the second case there was a swelling in the left loin with a history of "cystitis." Pyelography demonstrated a normal pelvis and calyces situated above the mass. Operation showed a hard fibrolipomatous mass adherent to the lower end of the kidney and to the colon in the midst of which were caseous masses. The details of the cases are given on a later page.

Let us now give some illustrations of the value of this method.

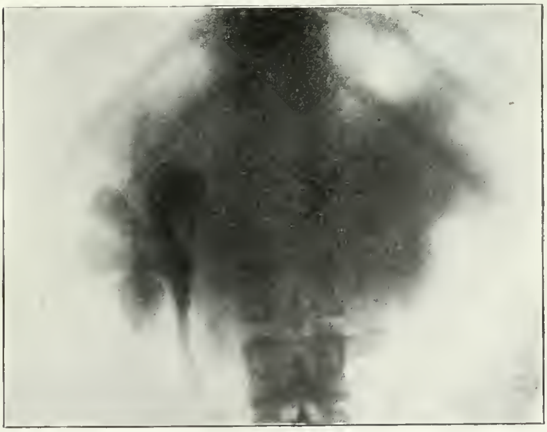
1. *Calculus impacted in the ureter. Is dilatation of the kidney commencing?* (Figs. 5 and 6.)

Fig. 5.



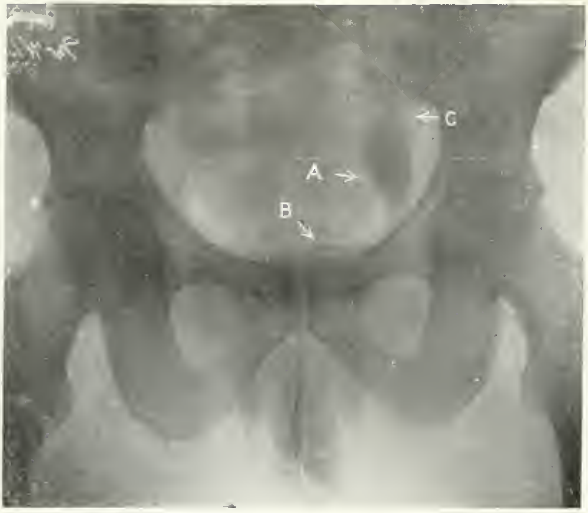
Calculus impacted in right ureter. Opaque bougie arrested by calculus.

Fig. 6.



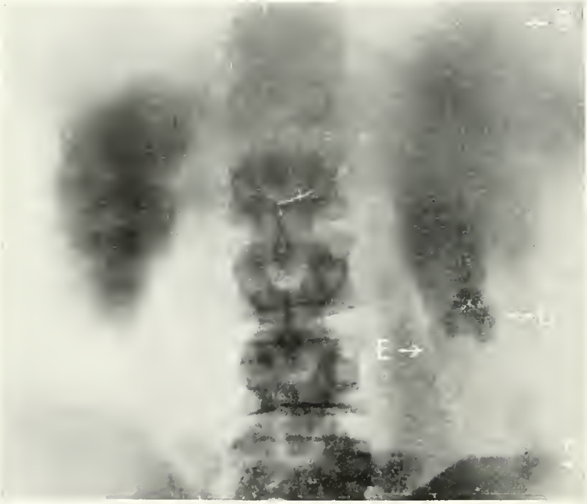
Early hydronephrosis due to stone in ureter. Note marked clubbing and elongation of calyces, pelvis normal.

FIG. 7



A, calculus in pelvic segment of ureter; *B C*, opaque bougie passed up ureter alongside it.

FIG. 8



A, hydronephrosis, left kidney, renal type. Note fine partitions (clear lines) between pockets. Large hydronephrosis, right kidney. *B*, upper limit of kidney; *C*, stone at lower pole of kidney; *D*, stone at renal pelvis; *E*, edge of psoas muscle.

Case V.—F. M., an engineer's fitter, aged forty-three, suffered from slight pain in the right loin and across the base of the sacrum and from difficult micturition for six or seven years. The difficulty in micturition was intermittent. It was worse when the pain was present and better when it was relieved. The pain came on in attacks with intervals varying from 14 days to 12 months. It radiated along the line of the right ureter into the right testicle and down the right thigh and might last for a week at a time. Occasionally there was pain in the left loin. There was no hæmaturia but the urine contained pus. He passed water every three or four hours during the day and occasionally once at night. The kidneys were not palpable or tender.

The X-rays showed an oval calculus of moderate size on the right ureter at the level of the brim of the pelvis. An opaque bougie was passed up the right ureter. There was a hitch at the level of the pelvic brim and the catheter passed on into the renal pelvis. Collargol was introduced and practically no sensation was felt in the kidney by the patient.

In the skiagram the ureter is seen to pass outward from the level of the fifth lumbar vertebræ to join the neck of the pelvis which lies vertically just outside the tips of the transverse processes of the second and third lumbar vertebræ.

The pelvis is vertically placed and is of the funnel-shaped variety becoming gradually larger as it passes upward. The pelvis does not appear to be dilated and is not in any way distorted. It gives off four large branches, the upper of which passes upward and outward, the next two directly outward and the lowest directly downward.

These branches are long and gradually expand into a rounded or clubbed extremity which reaches to the surface of the shadow of the kidney. They are separated by broad wedges of renal substance. The lowest expanded branch which passes vertically downward lies close to the neck of the pelvis and is only separated from it by a narrow space so that the two shadows meet in an acute angle. The kidney shadow is slightly increased in breadth.

In a radiogram of the pelvis a broad band of collargol shadow is seen lying transversely across the pelvis and represents a quantity of collargol which escaped from the kidney alongside the ureteric catheter.

I removed the ureteric calculus by the extraperitoneal route and the patient made an uninterrupted recovery.

2. *After removal of a calculus which has obstructed the ureter and caused dilatation of the kidney, does the kidney return to its normal state?*

Case VI.—A. W., aged thirty-three, came under my observation at the Hampstead General Hospital in July, 1910, complaining of pain in the left side of the abdomen. He had suffered from pain in the left loin after exercise since he was four years old. At the age of 20 he lost this pain, but had pain along the urethra and at the age of 26 the loin pain returned and has continued since. He had been treated for dyspepsia before he came under my care. Neither kidney was palpable. A radiogram showed a large calculus in the pelvic segment of the left ureter (Fig. 7). This was removed in July, 1910, and the ureter was found dilated. No obstruction to the passage of bougies along the ureter remained after removal of the stone.

In November, 1910, he suffered from continuous hæmaturia for some weeks from the right kidney, but this kidney could not be felt on palpation of the abdomen. In February, 1911, I examined the kidneys with a view to operation on the right. I wished particularly to ascertain if the dilatation which I knew must have existed in the left kidney still remained.

The left ureter was catheterized and 40 c.c. of collargol solution (10 per cent.) introduced. There was no pain. A radiogram showed a dense collargol shadow on the left side which had the outline and appearance of a dilated kidney (Fig. 8). The rounded pockets of the hydronephrotic kidney were represented as dark rounded collargol shadows and these were separated by fine clear lines representing the fibrous septa.

On the right side the upper part of the kidney shadow lay behind the eleventh rib while a stone shadow in the lower part of the kidney lay below the crest of the ileum and another, evidently the plugging calculus, lay at the edge of the psoas at the level of the third lumbar vertebra. There was evidence here of a very large hydronephrosis on the right side and a smaller hydronephrosis on the left, yet neither could be felt on palpation of the abdomen.

On July 15, 1911, I exposed the right kidney and found a thin hydronephrotic sac of large dimensions adherent to the diaphragm above and extending into the iliac fossa. The ureter was normal in size. The calculi were removed and the obstruction was found to lie at the junction of ureter and pelvis but so buried in fat and fibrous tissue as to be inaccessible. I therefore brought the ureter up to the lower end of the kidney and formed a short circuit between the cavity at the lower pole of the kidney and the lumen of the ureter by lateral anastomosis. The patient is well and at work at the present time (April, 1913).

3. *A stone has been passed from the kidney some years previously and there is recurrent pain but no calculous shadow. Is there stenosis of the pelvic outlet and commencing dilatation of the kidney?* (Fig. 2.)

Case VII.—The patient, aged twenty years, had had a stone crushed by the late Mr. Reginal Harrison at the age of six years after suffering from left renal colic. For the last five years he had had pain at the end of the penis on passing urine and this had increased during the last month. The frequency of micturition was increased to two hours during the day and there was some urgency. On exertion he had pain in the left side which he localized to the region of the left kidney. The left kidney could not be felt and was not tender.

The radiographer's report was that there was no opacity from calculus, but that there was some increase in the opacity of the left flank, whether due to the enlargement of the left kidney or not, was doubtful. On cystoscopy there was basal cystitis and a patch of cystitis on the right wall of the bladder. The right ureter was open with thick edges, but contracted wall, and the efflux was clear; the left ureter was large, open, oval and did not contract. The efflux was not seen. It was probable in this case that there was some dilatation of the left kidney due to the passage of a calculus some years previously and that the dilatation might be due to progressive contraction at the ureteropelvic junction.

An opaque catheter was passed up the left ureter and warm collargol slowly introduced. Pain was felt at 7 c.c. and a radiogram was taken. The plate shows the shadow of a dichotomous pelvis with calyces. The highest and lowest calyces are clubbed so that some dilatation is present, but it is insignificant. The ureter passes in a straight line into the pelvis so that there is no angling. The angle between the lowest calyx and the pelvis is wide.

From this examination I concluded that there was no important degree of dilatation and therefore no stenosis.

4. *A movable kidney is present and hydronephrosis is diagnosed. Is dilatation present, and if so, what is its extent?* (Fig. 9.)

In the following case hydronephrosis had been diagnosed by a competent surgeon and the diagnosis confirmed by a second surgeon. It was proved by pyelography that no dilatation of the renal pelvis or calyces was present.

Case VIII.—A. E., a servant maid aged twenty-nine, had an attack of pain in the right side of the abdomen in June, 1911, and was confined to bed for a week. In August she complained from time to time of dull aching pain in the right loin. In December, 1911, she had a severe attack of pain in the right iliac fossa radiating to the thigh and back, and accompanied by increased frequency of micturition, urgency and some pain and there was nausea and constipation. She was examined by a surgeon who did not feel the kidney on the first occasion but some days later a tender elastic swelling was felt in the right side of the abdomen which he regarded as a distended kidney. The patient stated that she felt a lump in the right side which disappeared at intervals and after relief from the pain she passed a large quantity of urine. Examination by a second surgeon gave on one occasion a negative result and on another a swelling was found. The case was referred to me as one of intermittent hydronephrosis in a movable kidney.

I was unable to feel the kidney on either side on the occasion on which I examined her and there was no tenderness. The bladder had a normal capacity and showed slight cystitis at the base, especially on the right side. A No. 7 silver wire bougie passed easily up the right ureter to the renal pelvis and collargol was introduced. The collargol solution flowed very slowly and required some pressure on the piston of the syringe. Pain appeared in the right kidney region soon after the injection of collargol was commenced, and rapidly became acute.

A radiogram (Fig. 9) taken by Dr. Ironside Bruce showed the following:

The ureter lay in normal position across the transverse processes of the bodies of the fifth to the second lumbar vertebræ. The line of the upper end of the ureter is continued straight into that of the neck of the pelvis.

The pelvis lay opposite the intervertebral disc between the first and second lumbar vertebræ. It was of the single funnel-like type and split into four calyces. The upper calyx continued in a gentle curve the line of the upper end of the ureter and the neck of the pelvis.

The angle between the lowest calyx and the neck of the pelvis was wide and formed a full curve. There was no dilatation of the pelvis, no clubbing of the calyces. The outline of the kidney was normal. By this examination it was proved that no dilatation of the renal pelvis or calyces was present. At the urgent request of the patient I operated to fix the movable kidney.

The fascia of Zuckerkandl was thick and the perirenal fat absent except at the hilum. Tough fibrous bands passed from the fibrous capsule to the perirenal fascia. The pedicle was long and the kidney readily delivered through the wound. The pelvis was small and there was no hollowing of the kidney. Nephropexy was performed.

5. *Nephropexy has been performed some years previously and there is aching pain in the loin. Is there dilatation of the kidney?* (Fig. 3.)

Case IX.—B. F., a spare woman of thirty-six years, had suffered from movable left kidney for which nephropexy had been performed ten years previously.

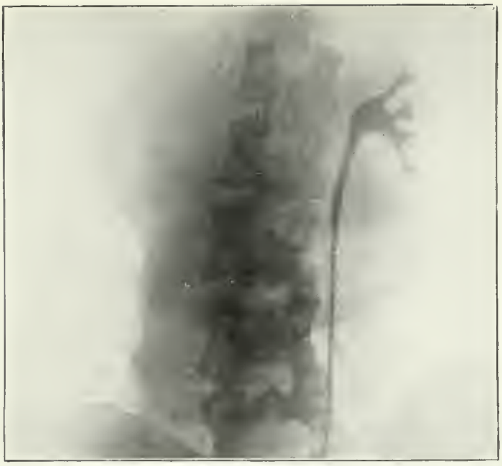
For the last five years there has been dull aching in the left loin and all over the left side. This occasionally became acute but never radiated to the groin or labia. She occasionally vomited during an attack of pain. The urine was always clear. Urine was passed every two hours during the day and every half hour during the night for several months. There was some difficulty in passing water when the pain was acute and when the pain ceased a large quantity of water was passed. The pain was worse after exercise. The right kidney was not palpable or tender. The left loin was a little tender, but the kidney was not palpable. On cystoscopy, the bladder and ureteric orifices were normal. There was no obstruction to the passage of a catheter up the left ureter. Collargol was injected and almost immediately pain was felt in the left kidney. A radiogram (Fig. 3) shows the ureter and pelvis in a continuous curved line passing upward and outward from the level of the transverse process of the fourth lumbar vertebræ. There is no kinking of the ureteropelvic junction. The pelvis is of the funnel-shaped type and is situated at the level of the upper part of the third lumbar vertebra and is lower and further from the vertebral column than normal. The point of the catheter is seen lying in the upper calyx having passed into it in a direct line from the ureter and neck of the pelvis. Passing outward from the pelvis are two branches, one of which passes transversely and another vertically downward from the lower angle. The angle between the lowest branch and the neck of the pelvis is wide. It will be seen from these details that no trace of dilatation of the calyces or of the pelvis exists.

6. *Nephropexy has been performed at a previous date, there is renal pain on movement and the kidney can be felt to swing laterally. Is there kinking of the ureteropelvic junction?* (Fig. 10.)

Case X.—A woman, aged forty-eight years, came under my observation at the Hampstead General Hospital. She complained of pain in the right side. The pain varied in severity and was relieved by lying down. There was increased frequency of micturition to every hour during the day and three or four times during the night. Nephropexy has been performed at another hospital eight years previously. On palpation the right kidney was readily felt in the right loin and the lower pole reached below the level of the umbilicus. I noted "the kidney appeared large, especially the upper part, which was more bulky than the lower part."

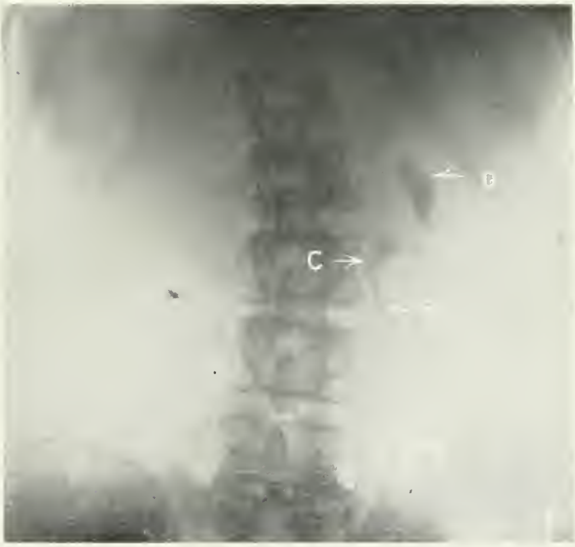
The kidney moved with respiration but had a comparatively limited excursion and the lower pole appeared to swing toward the middle line so that it lay transversely. The bladder and ureters were healthy. The capacity of the right renal pelvis was 27 c.c. Collargol solution (10 per cent.) was introduced and a radiogram taken. The radiogram (Fig. 10) shows the ureter passing up in front of the transverse processes of the lumbar vertebræ and opposite the body of the third lumbar vertebra, it

Fig. 9.



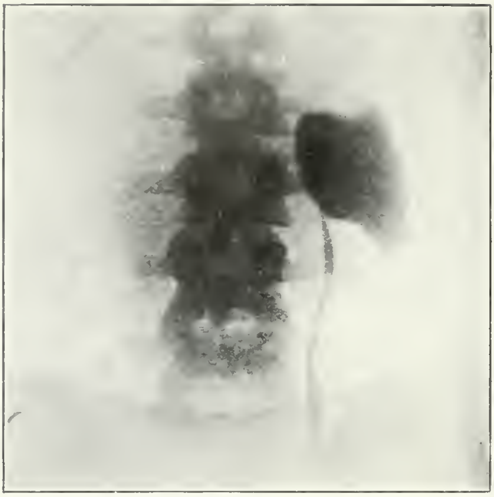
Case of supposed hydronephrosis, collargol shadow showing normal pelvis with calyces. Opaque catheter in ureter.

Fig. 10



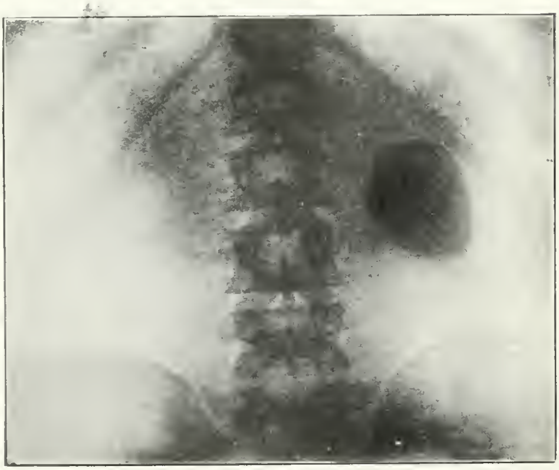
Movable kidney. *A B*, opaque catheter in ureter; *C*, kink at ureteropelvic junction; *D*, dilated calyx.

Fig. 11.



Hydronephrosis, pelvic type. Note dilated pelvis and on right of this dilated kidney; catheter raising up roof of pelvis; waves of collargol passing down ureter.

Fig. 12.



Hydronephrosis of pelvic type, due to pressure of aberrant renal vessels.

takes a sharp curve outward as it expands into the pelvis of the kidney. The upper calyx of the pelvis is very distinctly dilated.

I explored the kidney on March 15, 1911, and found an elongated kidney which was fixed by a band of fibrous tissue of the size of a shilling, to the tissues in the inner surface of the twelfth rib. This band allowed some amount of vertical movement, but the chief movement consisted in the lower pole of the kidney swinging toward the middle line. There was hollowing of the kidney which was most pronounced at the upper part. There was no narrowing of the ureter or ureteropelvic junction.

I looked upon the swinging movement as the cause of the angling of the ureteropelvic junction and dilatation of the upper calyx. The kidney was freed, the capsule stripped from its anterior and posterior surfaces, and the organ slung vertically by three catgut stitches, placed at intervals of an inch, both ends of the highest being passed through the intercostal muscles between the eleventh and twelfth ribs and tied.

In this case pyelography showed that the upper calyces were dilated, and confirmed the view that this was due to the abnormal position and the movement of the kidney.

7. *Examination of a dilated movable kidney after nephropexy showing an openly actively contracting ureter* (Fig. 11).

Case XI.—E. A., a servant maid aged twenty years, had suffered from pain in the back and right side for two years. She experienced the sensation of a lump in the side and there was an occasional attack of lumbar pain more severe on lying on her back. There was no history of Dietl's crises or of variations in the quantity of urine. The right kidney was freely movable and could be displaced into the right iliac fossa. It was not enlarged or tender.

Nephropexy was performed in February, 1912. The fascia of Zuckerkandl was thick and the perirenal fat entirely wanting. Tough fibrous bands passed between the thickened fibrous capsule and the fascia. The kidney lay in the iliac fossa with its upper pole below the level of the iliac crest. The kidney pelvis was large and flabby and the kidney sinus admitted three fingers. Nephropexy was performed by partial decapsulation and catgut suture. The kidney was examined by pyelography three weeks after the operation. Collargol entered the pelvis easily and there was no pain. The pyelogram (Fig. 11) shows a greatly distended renal pelvis and the outline of a dilated kidney. The pelvis is roughly quadrilateral in shape the upper and inner angle being formed by the catheter passing up this part of the pelvis. The renal portion of the shadow is a long oval shape with an undulating outline from the shallow pockets in the kidney being filled with collargol solution. From the lower and inner corner of the renal pelvis the ureter is seen to pass downward as a dark line varying in thickness as far as the level of the middle of the sacro-iliac synchondrosis. There are two narrow and two broad segments. The first narrow segment is at the uretero-pelvic junction at the level of the intervertebral disc between the third and fourth lumbar vertebræ, then there is a short thickened segment extending to the lower border of the transverse process of the fifth lumbar vertebra and from this to the lower limit of the plate the opaque line is much thicker. In the narrow segments only the opaque catheter is seen, while in the thick segments are collections of collargol.

The phenomenon of ureteral contractions is here graphically demonstrated. The lower segment between the two broad bands is the full length of a wave of ureteral contractions passing down the ureter. In the narrow portion an opaque segment of catheter, 1 centimetre in length, is lying and by using this it is found that the length of the contraction wave is two centimetres.

8. *Attacks of colic for three years, previous examination negative, recently left kidney felt enlarged. Collargol shows dilated pelvis. Aberrant renal artery on operation* (Fig. 12).

Case XII.—F. H., a dental mechanic aged twenty-one, had complained of attacks of pain in the left loin during the last three years. Two years ago he was admitted to St. Peter's Hospital on account of renal colic, but the examination by X-rays was negative and the kidney was not palpable. Since that time he has had attacks of renal colic on an average of once a fortnight. The pain commences as a dull ache in the left posterior renal region and steadily increases reaching the maximum in two hours and then it radiates down the left side of the abdomen almost to the groin. Sickness and vomiting accompany the attacks. There has never been a hæmaturia and there has been no sudden increase in the quantity of urine after the attacks. The kidney has on one occasion been found enlarged and tender. There was no stone shadow with the X-rays.

When I examined him both kidneys were palpable, but neither was tender or enlarged. On cystoscopy the left ureteric orifice was larger. The efflux from both was clear. A catheter passed up the left ureter without meeting any obstruction. After injecting 28 c.c. collargol there was some pain. A radiogram (Fig. 12) shows a large oval collargol shadow opposite the bodies of the second and third lumbar vertebræ. The long axis of the oval runs parallel to the edge of the psoas muscle and a rounded projection overlaps the edge of this muscle at the level of the intervertebral disc between the second and third lumbar vertebræ. No calyces are visible. The shadow extends outward almost to the twelfth rib. The ureter contained no collargol. A diagnosis of hydronephrosis due to obstruction at the ureteropelvic junction was made.

On exposing the kidney I found a large lobulated kidney and a greatly distended renal pelvis. A band containing a large artery and vein passed across the ureter immediately below the distended pelvis and entered the hilum at its lower part. Below this band the ureter was normal in size. Above the band a little more than an inch of ureter was dilated and bound down to the surface of the dilated pelvis. The pressure of the band upon the ureter was clearly made out. On raising the vascular band on an aneurism needle, the ureter still remained adherent to the surface of the pelvis and the contents of the pelvis could not be made to pass into the ureter. The pelvis was opened on its anterior surface and the interior inspected. The opening of the ureter into the pelvis readily admitted a probe and there was no valve or stenosis here.

The probe passed down for about three-quarters of an inch and was then arrested. The aberrant vessels were now tied and cut across, but the probe did not pass. The ureter was dissected off the surface of the pelvis and at once the probe passed on, so that the actual obstruction was due to the adhesions. No blanching of the kidney followed ligature of the abnormal vessels. The wound in the pelvis was closed with catgut and the kidney fixed to the posterior abdominal wall with catgut sutures. Convalescence was uninterrupted.

9. *A diagnosis of hydronephrosis has been made. Pyelography shows the renal pelvis normal in outline and position.*

Operation reveals hydatid cysts projecting from under surface of liver (Fig. 13).

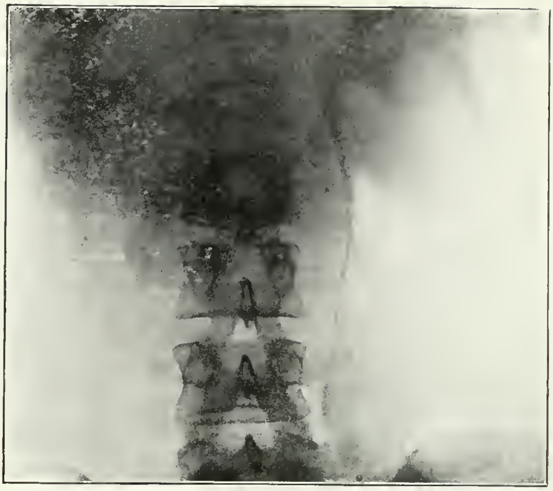
Case XIII.—L. C., a nursemaid aged twenty-seven, complained of attacks of acute pain in the right loin. Three and a half years ago she had an operation for appendicitis.

Four months ago she had a series of attacks of violent pain in the right side of abdomen situated over the right kidney and radiating transversely round the abdomen to the middle line but not downward. The pain commenced suddenly and was very severe, necessitating the administration of morphia. Vomiting usually accompanied an attack. There were about 12 attacks in the first week each lasting from 30 to 40 minutes. For three and a half months there has been no recurrence of the pain. An abdominal swelling was noticed when the pain commenced. She was examined after an attack of pain by a surgeon of recognized experience in urinary surgery who diagnosed an enlarged tender kidney and pronounced it a hydronephrosis or a tuberculous kidney. Since that time the swelling had remained unchanged.

When I examined her (November, 1912) there was a reniform swelling in the right side of the abdomen with the long axis placed obliquely from above down and inward. The mass was rounded and prominent and there was a rounded upper pole two finger-breadths below the costal margin. On the rounded outer border there was a nodule the size of a walnut. The inner border was depressed like the hilum of the kidney. The surface of the mass was smooth and the consistence uniformly hard. The mass moved in a vertical direction with respiration and was freely movable on palpation, passing downward to an inch below the level of the umbilicus and inward for two inches across the middle line.

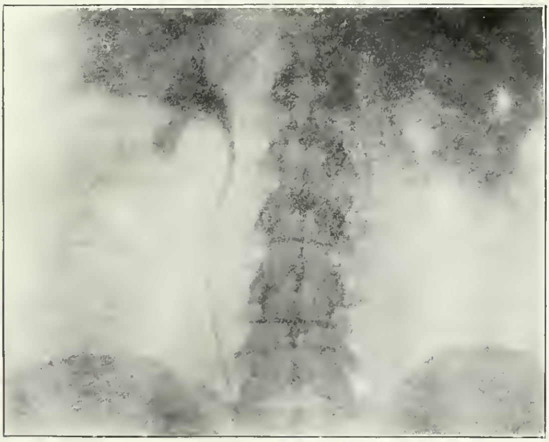
The urine contained no abnormal elements. Cystoscopy showed a healthy bladder and normal ureteric orifices. Pyelography (Fig. 13) showed the renal pelvis and calyces normal in size and contour and situated at the level of the twelfth dorsal and first lumbar vertebræ, high above the position of the swelling. On December 6, 1912, I exposed the right kidney and found it normal. The abdominal cavity was then opened and a long, firm, yellow, kidney-shaped mass found adherent to the under surface of the lower border of the liver. After removal of adhesions to the bowel this was found to be a hydatid cyst and was removed.

Fig. 13.



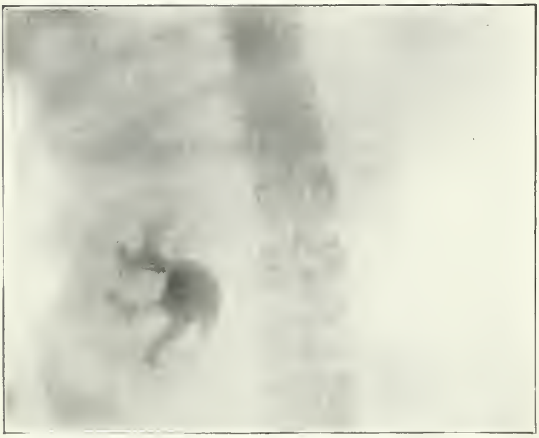
Normal pelvis and calyces in case of abdominal hydatid cyst, resembling hydronephrosis.

Fig. 14.



Normal renal pelvis and calyces in abdominal tumor, due to liver and enlarged gall-bladder.

Fig. 15.



Fully distended normal renal pelvis and calyces, outline of kidney normal, sarcomatous mass seen below the kidney.

The liver contained numerous large cavities filled with cysts and these were drained. Recovery was uninterrupted.

10. *An abdominal tumor is present in the right loin. Pyelography shows the renal pelvis and calyces normal and situated high up above the tumor. At operation the swelling is found to be the right lobe of the liver and gall-bladder full of gall-stones.*

Case XIV.—A. S., aged forty-two years, had suffered from attacks of pain in the right side of the abdomen and right iliac fossa for a year. The pain was very severe lasting for a few hours to a day and was accompanied by sickness and constipation. There was said to have been hæmaturia with the first attack, the blood being present in the urine for a week. At the commencement of the first attack the patient was said to have been jaundiced for two or three days, but this has not been noticed since.

There was a swelling on the right side of the abdomen extending from the costal margin to the iliac crest and inward to the middle line. The swelling was rounded on the surface and there was no sharp edge. It did not pass back into the costomuscular angle. The urine showed evidences of chronic interstitial nephritis and there was a high blood-pressure and changes in the heart and arteries. Pyelography was performed without difficulty there being a remarkable absence of pain when the renal pelvis was full of fluid. The renal pelvis and calyces were normal (Fig. 14) and the kidney was situated high up under the ribs well above the prominent part of the tumor. The abdomen was opened. The right lobe of the liver was dragged downward and inward and its margin concealed by masses of adhesions. The gall-bladder was packed with gall-stones and extensively adherent. The gall-stones were removed from the gall-bladder and cystic duct and the adhesions freed. Recovery was interrupted by an attack of hæmaturia resulting from an exacerbation of the chronic nephritis.

11. *A tumor in the left loin is suspected to be renal. Pyelography demonstrates the pelvis and calyces normal and situated above the mass which is found on operation to be a mixed celled sarcoma of the perirenal tissue* (Fig. 15).

Case XV.—M. T., aged fifty-nine years, gave a history of "inflammation of the bladder" three months previously followed by dull aching pain and tenderness in the left loin. She then felt a "lump" in the left side which was heavy and tender.

Examination of the abdomen showed a tumor in the left loin at the level of the iliac crest. This had a rounded lower border and passed upward beneath the ribs. It gave the impression of a partly distended hydronephrosis.

The renal pelvis held 18 c.c. and the collargol solution (20 per cent.) flowed easily. There was no trace of discomfort and the introduction was stopped as the flow had ceased. Radiography showed the renal pelvis tensely distended with collargol solution (Fig. 15). There are three primary divisions and each splits into two branches. There is no dilatation of the calyces. The renal outline is normal. At the lower end of the renal shadow there is a dark opaque mass. No pain followed the examination and the kidney was palpated next day without a trace of tenderness. An oblique incision was made and the lower pole of the kidney was found to be embedded in a hard apparently fibrolipomatous mass which extended downward into the left iliac fossa and inward beneath the descending colon. The colon was firmly adherent to the mass and was dissected off with considerable difficulty. It was impossible to separate the mass from the lower pole of the kidney which was invaded by it and nephrectomy was performed. On section of the kidney the pelvis was found to be normal and the mucous membrane healthy and glistening. The lower pole of the kidney showed streaks of fibrous tissue passing in from the surface with a few small yellowish patches and a greatly thickened capsule. Microscopical examination showed the mass to be a mixed celled sarcoma with large areas of degeneration and infiltration with inflammatory round-cells. The growth originated outside the kidney capsule.

DIFFICULTIES, FALLACIES AND DANGERS OF PYELOGRAPHY.

The method so far as can be judged by published work has been successful in the hands of a few observers, while others have had to confess to failures in a number of cases.

It would be surprising if, at first, some failures did not occur in a method which is dependent upon a high degree of manipulative skill on the part of the surgeon and corresponding proficiency on the part of the radiographer. That some failures should have occurred does not appear to me to detract from the value of this method.

I have on two occasions failed to obtain a shadow on the first attempt. When the absence of a shadow was discovered the operation was immediately repeated and in each case was completely successful, one of the plates being as good as any that I have obtained. In both cases an opaque catheter was used and the first plate revealed the fact that the ureteric catheter had been pulled out in withdrawing the cystoscope and did not reach beyond the brim of the bony pelvis. As a result the collargol solution had escaped downward into the bladder. It is important, therefore, to use an opaque catheter and one which is marked in segments easily read by the unaided eye, so that the surgeon may know on introducing the catheter how far he has passed it up the ureter. The eye of the catheter should be within the renal pelvis and the distance which the catheter must travel up from the ureteric orifice is usually twelve or twelve and a half inches. Further, care must be taken to avoid pulling on the catheter during the removal of the cystoscope.

In a third case, the only other failure that I have had, there was an interval of over ten minutes between the introduction of the collargol and the taking of the radiogram. During this time the collargol had escaped down the urethra outside the catheter for the plates showed the catheter in good position and the collargol shadow in the bladder.

In one case I did not at first discover a shadow and thought that the collargol had failed to show on the plate. On further search I found, however, that there was the shadow of a normal pelvis lying on the shadow thrown by the ileum—and partly obscured by it. Dr. Blum[5] states that the method is useless in closed hydronephrosis. The objection cannot be a very serious one. Completely closed hydronephrosis is in my experience a rare condition and is one in which the diagnosis is seldom in doubt. The application of the collargol method to it is rather of academic than of practical interest. In the temporary closure of an intermittent hydronephrosis the ureteric catheter after a slight hesitation passes on into the sac, the contents can be emptied, and if desired, collargol solution can be substituted. The real use of the collargol method is not, however, in these advanced cases but in the early cases when genuine difficulty in diagnosis exists.

There is said to be danger of injecting the whole kidney tubules and of causing rupture of the renal pelvis with the collargol solution.

On examining the basis for this statement it will be found that the condition was produced on the dead body with the exception of one case (Oehlecker), where it occurred in a child of ten years. In this case the fluid was " injected under high pressure." Were this fact not definitely stated, I would have considered it superfluous to insist upon the utmost gentleness of manipulation and delicacy of touch in everything connected with ureteral and pelvic work of this nature. If this cannot be guaranteed, the surgeon had better leave such methods alone.

I did not " inject " the collargol solution. It is run in by raising the small glass receptacle six or twelve inches above the level of the urethra.

Further, anæsthetics should be avoided as pelvic pain is a valuable guide to the surgeon and one that should receive instant attention.

Finally a fatal case has been recorded by Roessle where " cauterization of the entire mucous membrane of the kidney pelvis and inhibition of the pyramids with collargol " (Blum) was found. This case was quite exceptional.

I have operated upon a considerable number of cases within a week of the collargol injection and have found the mucous membrane of the pelvis healthy and glistening even where the contents of the pelvis were still deeply stained with collargol.

In a recent case I performed nephrectomy two days after an examination with a 20 per cent. collargol solution. Microscopical examination of the mucous membrane of the renal pelvis showed the epithelium normal in appearance.

So far as I am aware no such cauterization as that recorded by Roessle has occurred in the experience of other observers. I have to thank my colleague Dr. Ironside Bruce, radiographer to St. Peter's Hospital, for the care and skill that he has devoted to the production of the radiograms illustrating this article.

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THE VALUE AND LIMITATION OF DIASTASE, UREA AND PHTHALEIN IN ESTIMATING RENAL FUNCTION IN ASSOCIATION WITH URETERAL CATHETERIZATION.

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Recently Wohlgemuth[1] has introduced quantitative diastase estimation of the urine as a method of determining the relative functional capacity of the two kidneys. In a series of normal cases he found the diastatic activity the same, or practically the same, on each side, while in unilateral disease the diastase content of the urine from the pathological kidney was always lower than that from the normal kidney. Simultaneous determination of function by means of cryoscopy, phloridzin and indigo-carmine showed that a certain amount of parallelism existed between the findings of these various tests and the amount of diastase present. He suggests that the diastatic activity may be of value in determining the advisability of nephrectomy in certain instances.

In our previous communications[2] the undoubted value of phthalein in these connections was demonstrated. Urea, and in certain cases indigo-carmine, phloridzin and Albarran's polyuria test were utilized in conjunction with phthalein. Attention was called to a certain advantage which phthalein has over the other tests, viz., that it reveals not only the relative but the accurate absolute functional capacity of each kidney, thus allowing a prognosis concerning the ability of the remaining kidney to carry on unaided renal function. As a result of these studies it was learned that the employment of all of the tests in any one case was impracticable, time consuming and also unnecessary, since the urea and phthalein furnish all available information. In a series of 40 cases the study of the phthalein output, of the urea per cent., total urea, and diastase from each kidney is here presented, an effort being made to determine the relative reliability and practicability of these tests as well as to ascertain what advantages, disadvantages and limitations pertain to each.

The Technic Employed.—The diastase has been determined according to the original technic of Wohlgemuth which is as follows: After neutralization, the same amount of urine from each side is placed by means of an accurately graduated pipette in a series of twelve test tubes in amounts decreasing from 0.6 c.c., 0.5–0.1–0.04 c.c. A sufficient quantity of 1 per cent. NaCl solution is then added to bring the amount of fluid in each tube up to 1 c.c.[1] To each tube is added 2 c.c. of a 1/1000 solution of freshly prepared soluble starch. The tubes are immersed in a water bath at 38° C. for 30 minutes after which they are placed in cold water for 3 minutes. To each tube is added sufficient 1/50 N. iodin solution to elicit a permanent color, violet or blue occurring where digestion is not complete. The tube in each series immediately preceding incomplete digestion of the starch indicates the diastase content of that particular urine and from this the d is calculated. d is the diastatic activity expressed as the number of c.c. of 1/10 per cent. starch solution capable of being digested by 1 c.c. of the urine utilized.

It might be emphasized that neutralization of the urine is important. In one case in which the urine on the left side was extremely alkaline, determined on the unneutralized sample, d was 4, whereas after neutralization it was 20. Although an extreme case this indicates the necessity of neutralization in every instance.

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[1] One c.c. of urine was diluted to 10 c.c. and from this diluted urine the measurements of the amounts less than 0.1 c.c. were made.

Urea was determined in all of the earlier work by means of the Doremus method. In some of the later cases, however, Marshall's [3] new area method was utilized.

The phthalein test was utilized according to the technic described in previous communications, except that the drug was given always intravenously and collections made for 15 minutes or half-hour periods.

In forty cases fifty diastase determinations were made. The general result coincides fairly well with those of Wohlgemuth in that in the majority of instances the diseased or more diseased kidney is correctly indicated through the decreased diastatic activity of the urine from that kidney. Where the various tests harmonize no comment is necessary. One case, however, is of sufficient interest to justify a detailed report, because it afforded an opportunity for an extensive and prolonged study of function and also the opportunity to observe the effect of a pyelotomy on the function of the operated kidney, as well as the effect of this procedure and of the anæsthetic on the function of the other kidney.

There was complete blockage of the right ureter, the urine draining from a renal fistula, the result of an operation for a calculus seven years previously. The urine only from the left kidney passed through the bladder. This kidney contained in its pelvis a large calculus which was associated with a slight infection.

The total function was practically normal, 41 per cent. phthalein for one hour. All three tests indicated the left kidney to have a functional capacity double that of the right. At operation under gas and ether anæsthesia a large bifid kidney was encountered on the left side, the lower half showing a marked hydronephrosis, the upper half, healthy kidney tissue equal to the size of a normal kidney. The stone lay in the pelvis of the lower half and was removed through an incision in the pelvis (Dr. Young). Although no dissection was done to determine the exact anatomical condition present, it seemed very evident that the kidney had a double pelvis, the stone lying in the lower one, the upper pelvis entering into a common ureter below the stone and being consequently free of obstruction. This upper hypertrophied kidney tissue explained the presence of the practically normal total function in the presence of these severe bilateral renal lesions.

The day after the operation (the right kidney not having been disturbed) the function of the right kidney dropped to one-half its previous capacity, while that of the left dropped to one-third, the function of two sides being now identical. The time of appearance from the right was 40 minutes as compared to 15 minutes prior to operation. The function of each kidney gradually improved until at the end of three weeks the level which existed previous to operation was reached.

In certain cases differences in functional capacity, as indicated by these various tests, exist, a consideration of the details of these differences furnishes information as to the relative value and limitations of each test.

In Case I there was a slight grade of pyelonephritis of the right kidney and some hydronephroses. The phthalein indicated the function of this kidney to be half that of the left, while the total urea indicated identically the same ratio. The diastase, however, showed a very much greater function on the left than on the right side, and when the greater quantity of urine from the left side is considered this disproportion would be even more exaggerated. The phthalein and total urea appeared to be more in accord with the clinical findings. In this instance the urea per cent. was of no value.

While from our results it is quite evident that differences in diastase are not so readily caused through dilution as differences in urea per cent., dilution in relation to diastase is not a negligible factor as is exemplified by one of our cases. In Case XI, a slight left-sided pyelitis, the phthalein was equal from the two sides, indicating equal function. This was corroborated by the total urea. The diastase showed a marked difference on the two sides. But if corrected for dilution the total diastatic activity would be practically equal.

In the presence of an unmistakable tuberculosis of the left kidney (Case XXXVI) in which the decreased function was indicated by phthalein, urea per cent. and total urea, the diastase failed to reveal any differences in function. Total diastase, however, would be more in accord with the true functional condition, but this furnishes no information other than is available from phthalein and urea. Case XXVII is another instance of the same phenomenon.

In two other cases which clinically presented no signs or symptoms of renal disease, a marked difference in function on the two sides was indicated (Cases XIV and XX).

These six cases serve to demonstrate that diastase is not an infallible index of relative functional capacity, since in two apparently normal cases considerable differences existed between the two sides, in two cases a definite lesion was not indicated, in another the functional injury was exaggerated, while in the sixth case unless the quantity of urine was taken into consideration an erroneous impression of function was given.

The diastase is of very considerable value, however, in the majority of cases. It is about equal in value to urea per cent. In some cases it may be of even greater value than urea per cent. because of the fact that it is not so readily affected by dilution. In the cases of free urinary secretion, which are usually cases without ureteral inhibition, the phthalein gives much more accurate information and in such cases diastase and urea are of minor value only.

The employment of functional tests in association with ureteral catheterization is attended with two great difficulties which in certain cases make it impossible to obtain all desirable information from any one test: (1) Inhibition of function and (2) leakage around the ureteral catheter.

1. *Inhibition.*—Any discrepancy due to inhibition can be detected readily through the determination without ureteral catheterization of total renal function by phthalein and error can thereby be avoided. For instance, with a total phthalein excretion normal or nearly normal, one kidney at least is normal or practically so. If, in such a case, on ureteral catheterization one should find on one side decreased function, which under ordinary conditions would be an indication for

nephrectomy even though the function of the supposedly healthy kidney as estimated with the aid of the catheter showed an apparently dangerously low excretion on account of the inhibition, one need not hesitate about removing the diseased kidney. The low function here is clearly the result of inhibition, the extent of which is indicated by the discrepancy between the separated functions and the total function without ureteral catheterization.

In cases of bilateral tuberculosis, the amount of pus from each side being practically the same, the phthalein can demonstrate that one kidney has a function far in excess of the other—a function sufficiently good to allow of successful nephrectomy. However, in certain instances inhibition might be so marked and the elimination of phthalein from each side consequently so small that it might be impossible from phthalein alone to determine which is the better kidney. Here diastase and urea per cent. together with a difference in the intensity of urine pigment and a consideration of the total phthalein would be of value. No such instance, however, has yet been encountered. In the majority of cases the influence of inhibition can be minimized through longer collections (½ to 1 hour).

Occasionally owing to extreme nervousness on the part of the patient or on account of unusual pain attending the presence of the catheter in the ureter, the time of catheterization must be curtailed to such an extent that an accurate quantitative determination of function is impossible. Here one is obliged to secure all of the necessary information from microscopical and clinical data and from urea per cent., time of appearance of phthalein and possibly of diastase, provided sufficient urine has been excreted to allow the application of the tests.

2. *Leakage.*—In order to obtain an accurate quantitative estimation of the function of each side it is necessary to secure complete collection of the urine. By the use of Albarran's flute end catheter this is usually possible. In a certain proportion of cases, especially those with relaxed ureters, leak-

age does occur and sometimes in amounts sufficient to nullify the findings. Unless one repeats the catheterization, which is not always practicable, using the Garceau catheter on one side along with transvesical collection for the other, knowledge of the relative functional values must be largely obtained from urea per cent., diastase and time of appearance of phthalein. This was well illustrated in a case with normal kidneys in which so much leakage occurred that the estimation of the relative function from phthalein was impossible, but the diastase, urea per cent. and phthalein appearance time all indicated identical functional capacity on the two sides.

Combination of Tests.—The number of tests has increased to such an extent that the use of all of them is impracticable. It becomes necessary, therefore, to consider what tests are really necessary for all of the available information under all conditions. In order to make a judicious selection it is necessary that one be familiar with the peculiarities, advantages, disadvantages and limitations of each and all of the approved tests.

Interpretation of findings is not always easy but in order that this may be made simpler, our ideas relative to the indications for the employment of any one of these tests alone or in combination, together with the significance of their findings, are here presented.

The phthalein test is incomparable so far as total function is concerned and gives information frequently unavailable from any other source, and in cases in which leakage and inhibition are absent furnishes in itself all the information necessary in regard to the function of each kidney. The absolute on each side as well as the relative function is revealed.

It is advisable to give the phthalein intravenously and to make collections for one-half to one hour periods when an accurate quantitative knowledge of the function of each kidney is desired, because as was previously pointed out, short periods of collection are not reliable. In the majority of instances, however, where it is necessary only to ascertain if the remaining kidney has a sufficiently good function to warrant operation, shorter periods (15 minutes) suffice.

In exceptional cases where marked inhibition or severe leakage occurs, diastase and urea per cent. may furnish most important information in conjunction with microscopical and clinical data. Diastase is subject to the same errors as urea per cent. except that it is not so readily influenced by dilution. The findings of either must be accepted with extreme caution and only when, for causes mentioned above, total urea and quantitative phthalein determinations are impossible.

The method of procedure which has furnished the greatest amount of information is as follows. In all cases demanding ureteral catheterization the total functional capacity is first determined by phthalein without ureteral catheterization. Where the total function is low a cryoscopy of the blood serum or a blood urea determination is made (Marshall's method). After ureteral catheters are in place and a flow of urine has become established the phthalein is given intravenously and the time of appearance on the two sides noted. Urine is then collected for periods of from 15 minutes to 1 hour starting from the first appearance of the drug, the length of the period depending upon the character of the information desired. Where leakage or inhibition of a grade sufficient to interfere with quantitative determinations does not occur, the quantity of phthalein from each side during a period of 15 minutes or preferably one-half hour is considered the index of the function of the individual kidney.

Total urea estimations almost invariably corroborate the findings of the phthalein as regards the relative function.

In the presence of considerable leakage dependence is placed upon the time of appearance of the phthalein, urea per cent. and diastase.

In the presence of inhibition the urea per cent. and diastase are the factors of greatest value taken in conjunction with the clinical findings.

Practicability of Tests.—The phthalein and Marshall's urea determinations are made with great ease and take but little time. The diastase while exceedingly simple is time consuming. Freshly prepared soluble starch solution is needed anew each day and at least a half hour actual time is necessary for each test.

CONCLUSIONS.

1. That diastase is of value in the majority of cases in indicating which is the diseased or more diseased kidney.

2. That in the majority of instances it is not necessary and adds nothing to the information obtainable from the phthalein or urea determinations which are more easily made.

3. That in cases with leakage or serious catheter inhibition, but where sufficient urine to allow a diastase determination has been obtained, the test is of value.

4. That dilution affects the urinary diastase content to a less extent than it does urea per cent.

5. That dilution is not a negligible factor in regard to this test, total diastase content being at times of greater importance.

6. That neutralization of the urine is not a negligible factor in the technic of the test.

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REPORT OF A CASE OF PELVIC KIDNEY: DIAGNOSIS BEFORE OPERATION.

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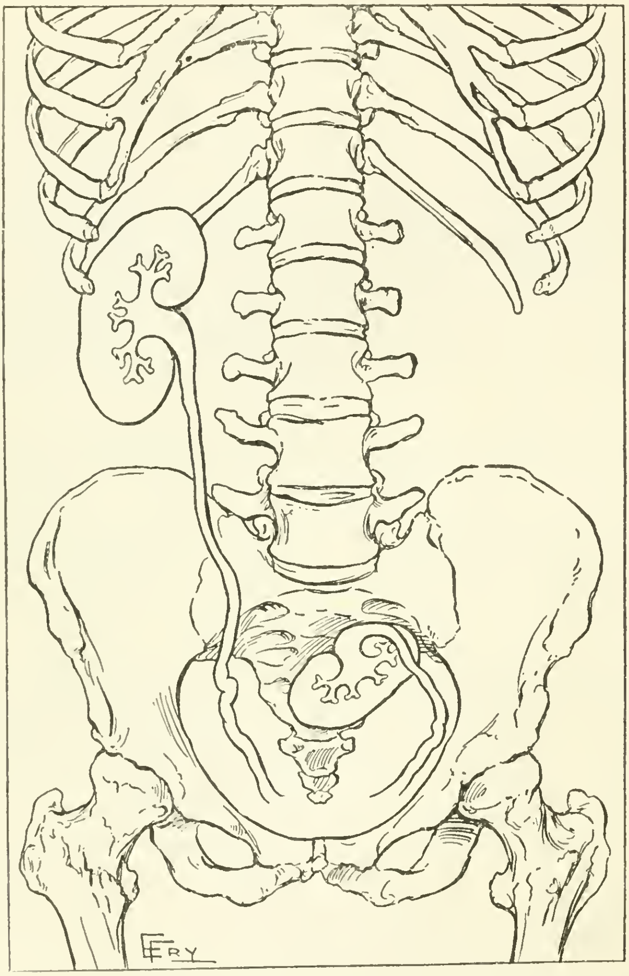
As a means of diagnosticating congenital anomalies of the urinary tract the radiogram, following the injection of colloidal silver, is of great value inasmuch as it demonstrates accurately the position, size and number of kidneys, and the condition of the ureters. The following case report is an example in which this method was used and the diagnosis made before operation.

Case A75609.—Mrs. P., aged thirty-two, married. Fourteen years previously the patient had been examined in the Mayo Clinic. At that time she had not menstruated. Physical findings: Vagina about one inch in length. No uterus, ovaries or tubes were discoverable upon palpation. Breasts normal and well developed. Family history: Eight sisters all having normal menses, five of them had married and borne children. Present history: Married seven years. No menses, but distress and pain over the region of the ovaries every two months. A year ago, following a cold or wet feet, she began to have attacks of frequent micturition. These attacks lasted six or seven days and then disappeared. She complains of a low abdominal pain, alternating from one side to the other, and she has been confined to bed for two or three days at a time with marked soreness and tenderness in the left pelvis. In sitting down and flexing the left thigh, and in leaning over, she has a severe sticking pain in the left side. She does not sleep well, cannot lie on her left side, is nervous and tires easily. Examination of urine (12 hour specimen): Specific gravity, 1018, 350 c.c., acid, no albumen, no sugar, an occasional red-blood cell. Objective symptoms: Vagina one inch long. No uterus palpable. Rounded mass about the size of an orange high in left inguinal fossa, tender to the touch. Slight thyroid enlargement. X-ray negative. Patient well nourished, but nervous.

Because of the congenital anomaly of the genital organs

FIG. 1.



Outline drawing of radiogram following injection of colloidal silver into the kidney and ureters. Note position of left kidney in bony pelvis. Normal position of right kidney.

without history of menstruation, the patient was referred for cystoscopic examination. Cystoscopy showed the urethra and bladder to be normal. It was difficult to pass the left ureteral catheter more than 5 cm., or 2¼ inches from the bladder. The right side appeared to be normal. Amount and character of the urine from the left side compared favorably with that from the right side. A double injection of colloidal silver by the gravity method was made and a radiogram taken. The passage of the cystoscope and the left ureteral catheter was so painful to the patient that the operation could not be prolonged long enough to give an intravenous injection for the purpose of making a separate estimate of the function of the two kidneys.

Fig. 1 shows the pelvis of a hydronephrotic kidney lying well down in the left bony pelvis. The ureter was 3½ to 4½ inches in length. The pelvis of the kidney was upward and inward from the cortex, and the ureter's course upward and outward then downward and inward. The position of the other kidney and the outline of the pelvis, normal.

The patient was operated on November 18, 1912, by W. J. Mayo. The position of the kidney was found as shown in Fig. 1. The pelvis was hydronephrotic and infected; the ureter about 4 inches long. The blood supply to this kidney came from two or three renal arteries from the left common iliac about one-half inch below the division. The renal vein entered the vena cava just at the bifurcation and was closely adherent to the kidney-mass. All of the left external iliac vein could not be found. It may have become fused with the internal or it may have been very small, due to the pressure of the adherent kidney.

MYOMA OF THE STOMACH.

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Tumors of the stomach, other than carcinoma, have been somewhat infrequently reported. Sarcoma is the most common: there are now over two hundred cases in the literature (Zeische and Davidsohn [1] and Briggs [2]). There are many specimens of papilloma and adenoma of the stomach in collections; they have largely been secured at autopsy and seldom have clinical significance. Lipoma [3] and fibroma [4] have been recorded. Leiomyoma of the stomach is much rarer. We have recently had a case of myoma of the stomach the record of which follows:

Abstract of History.—*Male patient, nine years old. Complaint, vomiting and general abdominal pain. A tumor in the epigastrium. Gastro-enterostomy June, 1912. Gastrectomy February, 1913. Tumor at the pylorus and involving a third of the stomach, microscopically a leiomyoma. Patient made a good recovery. X-ray study of the stomach with a bismuth meal after the operation.*

C. P., male, nine years old, the second child of his mother, was first seen on May 31, 1912. His father and mother were healthy; they are third cousins. They have one other child who is perfectly healthy.

The patient had an attack of erysipelas at the age of one and one-half years; and at the age of six a small right inguinal hernia was noticed which subsequently disappeared.

Otherwise he had always been healthy until two years ago, when he began to vomit at frequent intervals for days at a time. The vomiting was accompanied by general abdominal pain. During an attack of vomiting he was confined to his bed; between attacks he was up and about, leading the ordinary active life of a boy of his age. Hæmatemesis occurred once or twice at the end of an attack of excessive vomiting; he at no time vomited more than a half spoonful of blood. He did not lose much weight, but he was quite weakened. The bowels had been kept regular with cathartics.

Physical Examination.—On entering the hospital, May 31, 1912, he had a temperature of 97.4° and a pulse of 90. He was a pale, undersized boy. His hæmoglobin was 70. His heart and lungs showed no evidence of disease. His urine contained no albumin or sugar. A visible palpable tumor apparently the size of an orange presented in the upper portion of the abdomen above the umbilicus and in the midline. It was not tender.

June 1, 1912. Laparotomy was performed. The tumor was a smooth soft mass extending from the pylorus 8 cm. over the anterior and posterior walls and projecting into the lumen of the stomach. No enlarged lymphatics were felt. On account of the age and condition of the patient a two-stage operation was considered advisable. Gastro-enterostomy was done at this time and the patient's physician was told to return with him in from three to six months for excision of the mass.

The patient made an uneventful recovery from the first operation and seemed perfectly well for two months. He then had several attacks of vomiting at intervals of about a month which weakened him considerably, but at the time of his second entrance to the hospital on February 1, 1913, he appeared in fair physical condition. There was a small chain of palpable inguinal lymphatics on both sides not noticed in the previous history. On February 4, 1913, the abdomen was again opened. The tumor had apparently not increased in size. No glands were felt in the region of the lesser or greater curvature. Gastrectomy was performed; it was necessary to remove about one-third of the stomach in order to encompass the mass, which was excised. The patient again made an excellent recovery. He was discharged from the hospital two and a half weeks later in good condition. His temperature and pulse were normal. He was eating six small meals a day. Since then his progress has been very good. Two months after the operation he had gained twelve pounds in weight.

Macroscopic Appearance of the Tumor.—The tumor was 8 cm. in length by 6 cm. in thickness. It weighed 341 gms. It exactly occupied the site of the pylorus, extending for half its length along the greater curvature and front and back walls of the stomach. Fig. 1 is a side view of it with the pylorus cut open, the surface of the gastric mucosa above. Fig. 2 shows the mass bisected and the cut surfaces of the two halves. The dark spot at the lower pole is a cyst with smooth walls which was filled with brownish fluid. The white surface above this was firm and dense. The gastric mucosa was everywhere intact and freely movable over the surface of the tumor. The serosa also was intact and movable so that the neoplasm occupied the middle coats of the stomach.

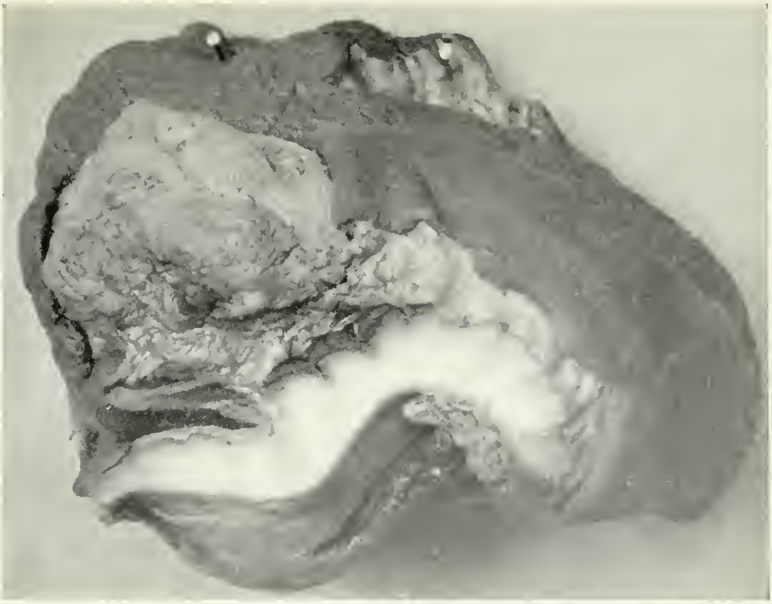
Microscopic Appearance.—Sections made through the firm white part of the tumor showed everywhere parallel bundles of smooth muscle fibres interlacing in all directions. In many parts there was some round-celled infiltration between the individual fibres. Although all relations here were lost it must have sprung from the muscular coat. With the Van Gieson stain it was seen that although there were many fibrous elements the muscle cells were in great preponderance (Figs. 3 and 4).

On February 21, 1913, he was given a bismuth meal and its progress watched with the X-ray. The bismuth entered the stomach very slowly and remained for some time above the cardia, trickling into the stomach slowly. After its entrance it settled in six to seven minutes in the lower pole of the stomach in a small mass and then began to leave the stomach by the gastro-enterostomy opening. Respiration facilitated the passage of the food into the intestine. The stomach was nearly completely empty in twenty minutes. Fig. 5 is a plate taken at the time the bismuth was beginning to leave the stomach after a second glass of buttermilk containing bismuth oxychlorid.

The literature upon myoma of the stomach is not large. The earliest collective report we have found is Steiner's,[5] who reported twenty-one cases of myoma and myofibroma of the stomach. Thompson[6] was able to collect forty-three cases which had only pathologic interest, and twenty cases of clinical interest. Of these, two (Moser's[7] and Capello's[8]) are reported as myosarcomata. Thompson then had eighteen clinical cases of leiomyomata or fibromyomata. To these he added one operated case.

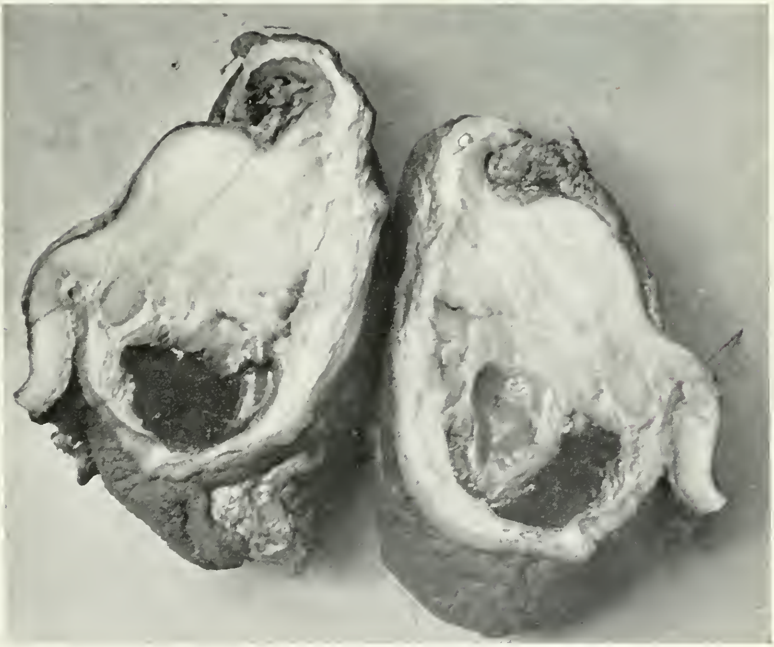
Kosinski's[9] case is the earliest reported—a male aged fifty-seven who had a tumor in the abdomen with symptoms extending over three years. Three days after aspiration of fluid from the abdomen he collapsed and died. At autopsy a tumor weighing twelve pounds was found attached to the greater curvature.

Fig. 1



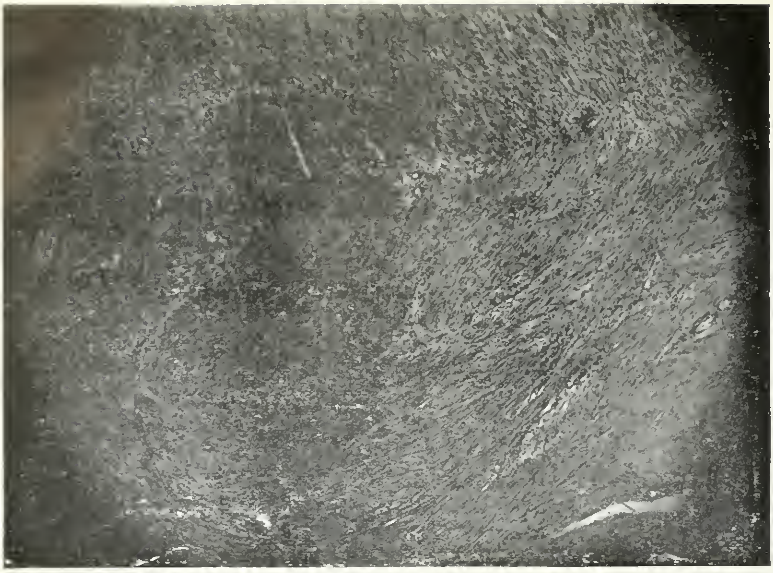
Appearance of the tumor, with pylorus cut across; the mucosa is above.

Fig. 2.



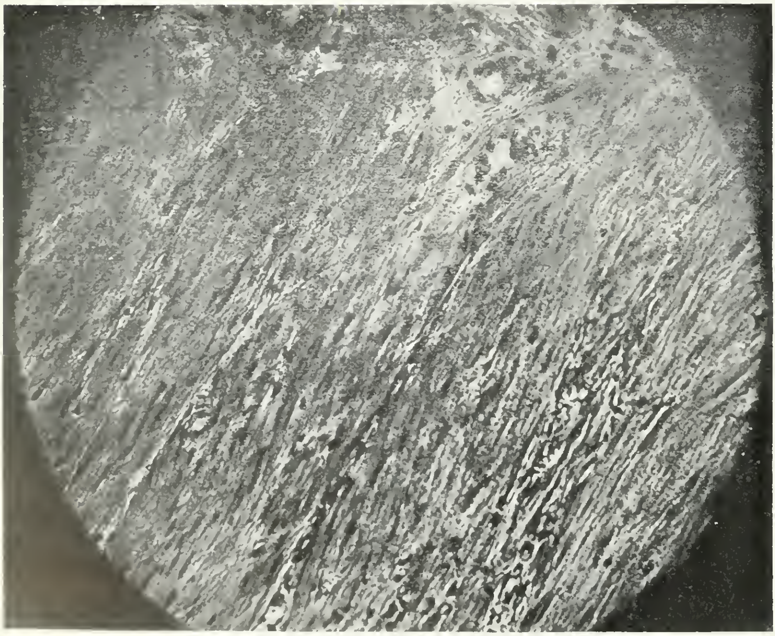
Section of the mass.

FIG. 3.



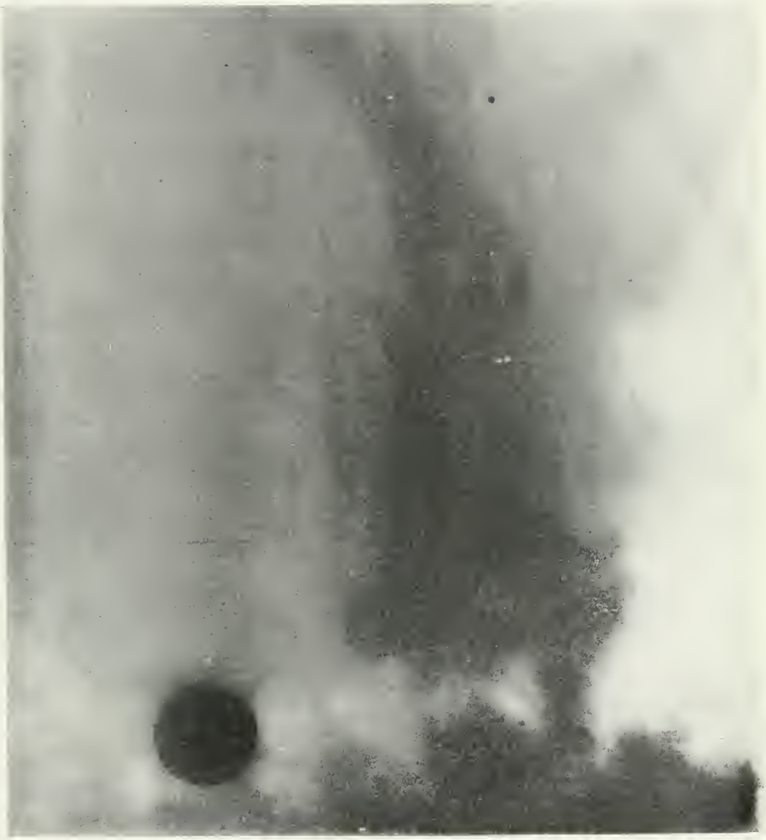
Microphotograph of a section made in the dense part of the tumor. (Low power.)

FIG. 4.



High power of a portion of Fig. 3.

Fig. 5.



Study of the stomach with bismuth meal.

Rupprecht[10] performed gastrectomy on a male aged fifty-two for a myoma weighing 251 grammes. Von Erlach[11] removed a stomach in a woman, thirty-four, with a leiomyoma weighing 5400 gms. The patient recovered.

Von Eiselberg[12] excised a fibromyoma of the stomach in a woman aged thirty who recovered. Nicoladoni[13] reported a fibromyoma in a man aged sixty.

Herhold[14] had a patient, female aged thirty-seven, who was operated on for persistent vomiting. She had a myoma at the pylorus the size of a hazel-nut. Bland-Sutton[15] reports a pure myoma found on the posterior wall of the stomach during an operation for gall-stones. Poirier[16] reports a cherry-sized myoma at the pylorus in a woman fifty-eight. Sainter[17] had a female patient forty-nine years of age who complained of nausea and emaciation. She had no palpable tumor but at operation a myoma was found at the pylorus: gastro-enterostomy resulted in recovery. Delore's[18] patient had a palpable tumor, a leiomyoma; he died two years after a gastro-enterostomy. Gouillioud's[19] patient was a male aged forty-four who had a tumor in the right hypochondrium. It proved to be at the pylorus. Pylorectomy and gastro-enterostomy were done. The patient was well six months later. Histologically the tumor was a leiomyoma. Ochsner's case reported by Yates[20] was a male aged seventy-three who was operated on for distress in the epigastrium. There was no palpable tumor. A tumor the size of a walnut was removed from the posterior stomach wall. It proved to be a myoma. Cholecystectomy was also done. The patient was well one year later.

Goebel's[21] case was a woman sixty-nine years old who suffered from an abdominal tumor and emaciation; a leiomyoma of the anterior wall of the stomach was removed. The patient died.

Thompson's[6] case was a woman aged forty-two. Four years after operation she vomited blood and passed tarry stools. She fainted many times during the four years and always passed tarry stools for days after a fainting spell. Later she suffered from pain in the epigastrium and emaciation. There was no palpable tumor. Operation revealed a large tumor growing from the posterior wall of the stomach. Partial gastrectomy and gastro-enterostomy were done. The patient was well six months later and had gained thirty-five pounds.

Hake[22] added three cases found in autopsy material; all small annular myomata at the cardia. Ferguson[23] catalogues a myoma of unusual size at the cardia. Shuyeninoff[24] reports two cases of malignant leiomyoma of the stomach. Battey[25] reports one case in a woman sixty-five years old; a diagnostic puzzle which proved at autopsy to be a suppurative leiomyoma of the cardia. Foulerton[26] describes a specimen removed by Bland-Sutton[15] evidently the same as described by him in a separate article. Spencer[27] reports a case in a woman aged forty-six who had a large submucous tumor which proved to be a fibromyoma. He mentions in his paper another case operated upon by another surgeon:

the tumor was the size and shape of a small sausage and sprung from the greater curvature; at operation it was supposed to be an intussusception and removed with a part of the stomach; the surgeon discovered his mistake and reopened the abdomen but the patient died.

Peugniez and Jullien[28] report two cases: one in a woman aged thirty-seven who for five years had attacks resembling acute appendicitis; at operation a small hard myoma was found at the pylorus, which was excised with recovery. The other was of a woman aged fifty-seven who had had symptoms of pyloric obstruction at the age of twenty-two and at the time of presenting herself for operation had vomiting, epigastric rigidity and retention of food. A diagnosis of gastric cancer was made and a laparotomy revealed a hard tumor encircling the pylorus; a pylorectomy was done and resulted in a recovery.

Mouriquand and Gardere[30] had a patient aged sixty-seven who entered the hospital for œdema and cardiac irregularity and died in a uræmic convulsion; at autopsy a large myoma was found on the posterior wall of the stomach.

Lowit[29] operated upon a woman forty-eight years old who suffered with diffuse abdominal pain. An elastic tumor presenting in the hypogastrium had been noticed for a year gradually growing until at the time of examination it was the size of a man's head. On opening the abdomen a cystic tumor containing 1.5 litres of fluid was found attached to the greater curvature near the pylorus. Microscopically it was a lymphangiectatic myoma. The patient left the hospital in two weeks.

Bullock[32] reports two cases in females aged sixty-three and fifty-six.

Anitschaff[33] reports three museum specimens all located at the junction of the stomach and œsophagus.

Farr and Glenn[34] report a case in a woman aged forty-nine who had profuse hæmatemesis and died shortly after. At autopsy a myoma was found in the fundus of the stomach. Farr and Glenn collect 84 cases but they include many cases of adenomyoma and myomata in association with carcinoma; all the reports of this sort that we have investigated have been of doubtful value.

There are then seventy-nine cases now on record including the one here reported. Of these twenty-eight have come to operation, or have been of clinical interest. The condition is usually considered to be carcinoma before operation and sarcoma at operation, until the microscopic examination is made. Sherren,[31] in collecting eighteen cases of polypoid tumor arising from the greater curvature of the stomach, states that often they are myoma malignum, and present as cystic tumors in the midline. These cases are similar to the cases of Kasinski, Lowit, Battey and Spencer.

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PRIMARY SARCOMA OF THE LARGE INTESTINE.*

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Statistics.—A somewhat careful survey of the material at my disposal shows a dearth of literature upon this subject until quite recently. According to Baltzer,[1] Stort found no cases in the reports of the Berlin Pathological Institute from 1859 to 1875. Undoubtedly many of the early cases were confused with other conditions and thus remained unrecognized.

Jopson and White,[2] in 1901 (*American Journal Medical Sciences,* v, 122), after a careful review, were able to find only 22 cases of sarcoma of the large intestine; and in 5 of these there was some doubt as to the growth being primary in the large bowel. In only 14 cases was the growth confined to the large bowel exclusively. Only 3 of this group were confined to the cæcum and ascending colon.

Location.—While in carcinoma of the intestine perhaps 95 per cent. occur in the large bowel, in sarcoma only about 35 per cent. are found there.

Corner and Fairbanks[3] collected 175 cases of sarcoma of the alimentary tract (exclusive of the mouth, pharynx and anus), with the following distribution: Œsophagus, 14; stomach, 58; small intestine, 65; ileocæcal, 20; colon, 11; rectum, 7.

G. A. Hamann[4] (*Surgery, Gynecology and Obstetrics,* September, 1909), in 1909, was able to find 4 additional cases.

We could only find 3 cases of sarcoma of the cæcum and ascending colon reported up to the time that I operated upon my case. The colon is most apt to be affected in childhood.

W. J. Mayo[5] in 1909 reports resecting twice for sarcoma of the intestine, in a paper on "Tumors of the Cæcum."

S. Goto,[6] in June, 1911, collected 24 cases of ileocæcal sarcoma, exclusive of those of the appendix, and gave 1 of his own. He gives 5 cases reported by Nothnagel, 2 by Frank and 3 by Baillet, making 32 in all up to June, 1911, which is the last report I can find.

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* Read before the Minnesota Pathological Society, March 18, 1913.

A. Baer[7] found 10 sarcomas in 124 inflammatory tumors of the ileocæcal region.

Pathology—Microscopic.—Whereas all varieties are found, the most frequent type is the round cell; and perhaps the lymphosarcoma is second in frequency.

Jopson and White report only one spindle-cell tumor in the twenty cases where the type was known.

The tumor probably usually begins in the submucosa, and may be pedunculated, or may infiltrate the bowel wall, causing great thickening; but does not often involve the serosa. Tendency to stenosis is not marked; and, indeed, dilatation may occur. The growth has a tendency to develop longitudinally in the bowel wall, and has not the predilection for points of irritation which is so often manifest in carcinoma. The abdominal lymphatics are apt to be involved early and extensively, and metastasis here is most frequent. Perhaps the peritoneum is next. The actual diagnosis cannot be made except with a microscope.

Incidence of Sarcoma as Compared with Carçinoma.—These growths, while having much in common clinically, have many distinguishing features which are unlike; but a classification of symptoms which might point to more than a probable diagnosis is impossible.

Generally speaking, sarcoma appears in younger individuals, grows more rapidly, and is more apt to show tumor. Wasting and anæmia are more marked, and pain is out of proportion to obstructive symptoms. Early cachexia and less liability to stenosis and to hemorrhage, and perhaps irregular fever are the most distinguishing features of sarcoma.

Treatment.—Excision offers the only hope. Glandular involvement is no contra-indication. So far results have been discouraging.

Corner and Fairbanks' statistics show a mortality of 33 per cent. in 51 resections. Of 11 resections in the large intestine, 7 survived the operation. Fourteen of 22 cases reported by Jopson and White were explored, and only 10 could be resected. Of these 5 died. Two cases of the 11 sarcomas of the colon were resected and both died.

Involved abdominal lymphatics should be looked for, and removed; and in cæcal growths the rule of excising at least six inches of the terminal ileum should be followed, as its lymphatic drainage is identical with that of the colon.

Report of Case.—Mr. A. S., aged sixty-one, had been under the care of Dr. L. A. Nippert for acute inflammatory symptoms relating to the right upper abdomen during the previous two weeks, during which time he was confined to bed. This was the first attack of this kind that he had ever had. He describes his previous attacks as follows:

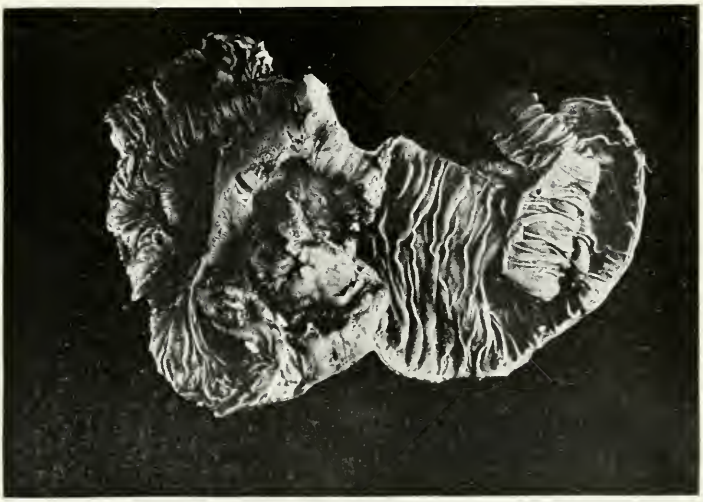
For about twenty years, with gradually increasing frequency, he had had attacks of partial obstruction, and after severe pain, and often vomiting, he would take a laxative and finally be relieved. There had never been any bleeding, but the stool had been dark at various times. Microscopic examinations for blood, by various physicians, had proven negative. A year or two previously a small tumor had been removed from the face, and pronounced by Dr. Corbett, who examined the growth, to be adenoma.

The skin presented a marked icteric tinge which was thought to be due to the gall-bladder condition. Local examination showed much rigidity in the right upper quadrant; and on deeper inspection a mass could be palpated in the right kidney region. The urine showed albumen, granular and hyaline casts, and decrease in quantity.

Operation.—Operation revealed a distended gall-bladder, greatly thickened, which was quickly drained, as the intestinal tumor had been explored and found to be operable. A classical resection, with lateral anastomosis by the method of Moynihan, was made. Several large glands were lifted out, with the growth, after mobilizing the bowel after the method of Lane. Drainage was employed on account of the gall-bladder infection.

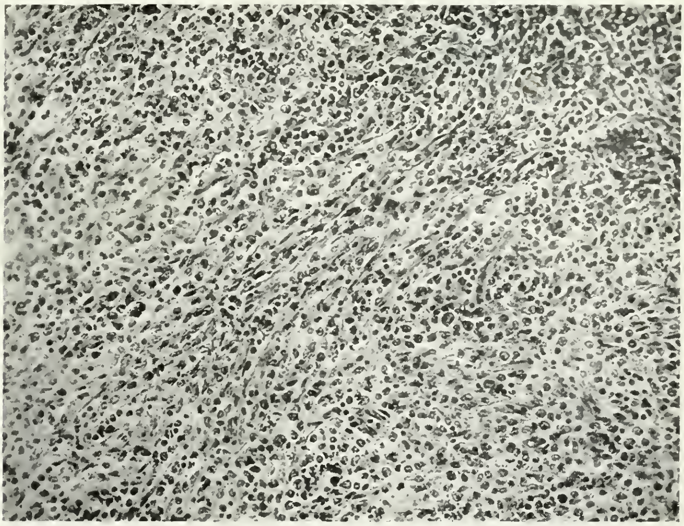
The output of urine was 32 ounces during the succeeding four days; but convalescence was otherwise normal. Since that time his health has been excellent.

FIG. 1.



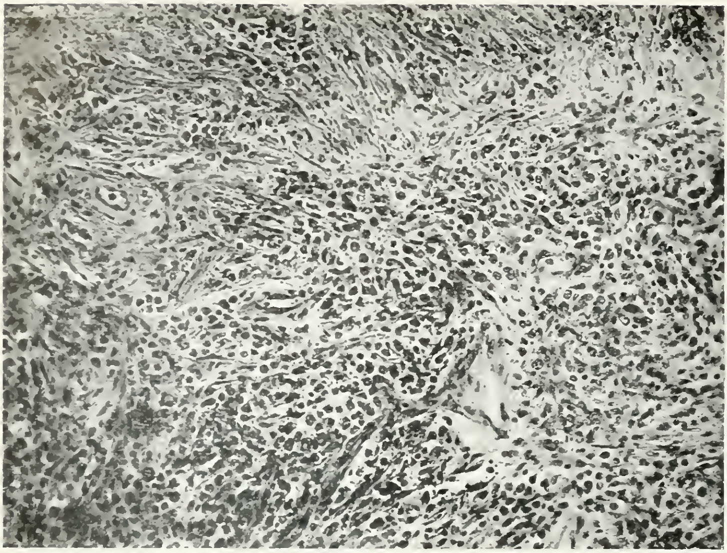
Photograph of gross specimen sectioned longitudinally. The sharp limitations of the tumor, the nodular projecting masses, the thickened walls and the absence of ulceration are the prominent features.

FIG. 2.



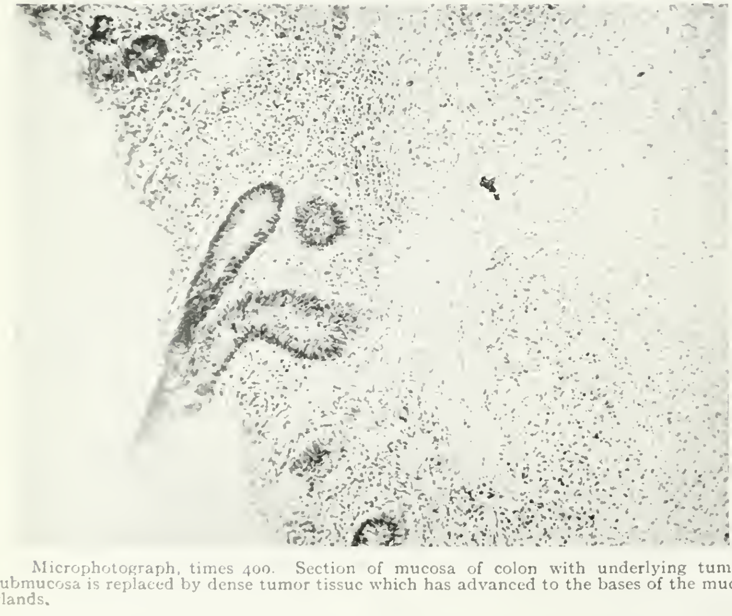
Microphotograph, times 500. Shows a fine fibrillar net-work with numerous rounded and oval nuclei.

Fig. 3.



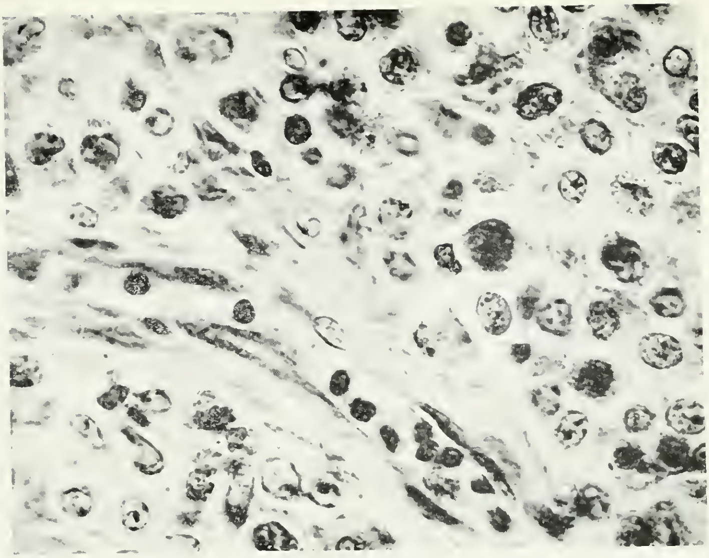
Microphotograph, times 500. Area showing numerous thin-walled vessels with slightly denser connective tissue bundles.

Fig. 4.



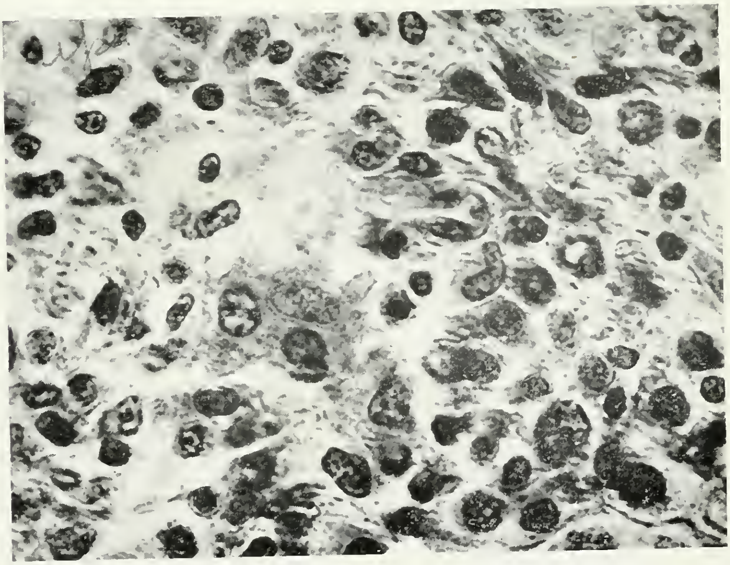
Microphotograph, times 400. Section of mucosa of colon with underlying tumor; submucosa is replaced by dense tumor tissue which has advanced to the bases of the mucus glands.

Fig. 5.



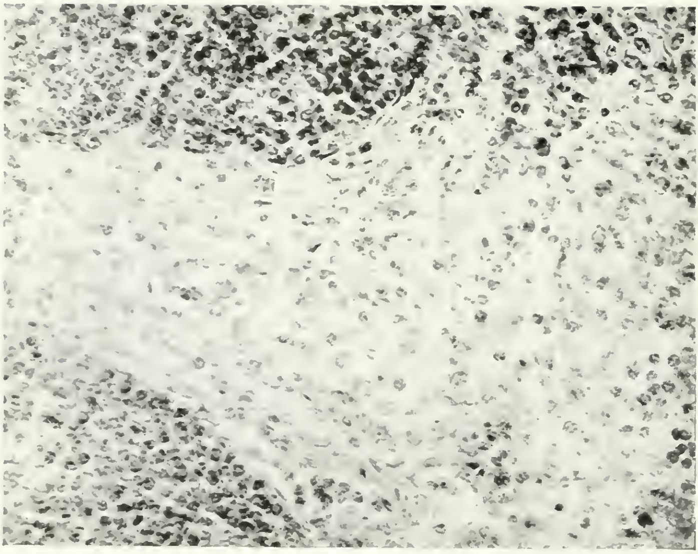
Microphotograph, times 900. Enlarged view of thin-walled capillary with surrounding tumor cells, some of which show mitotic figures.

Fig. 6.



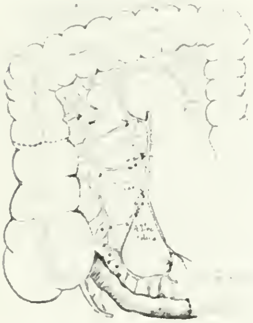
Microphotograph, times 1000. Showing characteristic arrangement of tumor cells which have vesicular nuclei of irregular size, shape and staining reactions. The fine intercellular fibrillæ are represented in upper right hand corner.

Fig. 7



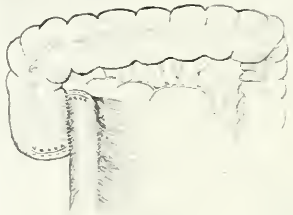
Microphotograph, times 700. Section of adjacent lymph node showing tumor metastasis in sinus.

Fig. 8.



Points at which the intestine was divided.

Fig. 9.



Points of lateral anastomosis.

He now weighs 200 pounds and his bowels move normally. The tumor involved almost all of the ascending colon, but its thickest point was at the cæcum, and it probably began here.

Pathological Report (by Dr. H. E. Robertson, of the University of Minnesota).—Gross specimen consists of cæcum with portions of ileum and ascending colon. In its preserved state the ileum portion measures 25 cm. in length. At the ileocæcal junction is an irregularly lobulated tumor mass, sharply defined on either side and occupying the proximal 6 cm. of the cæcum and ascending colon. A portion of the ascending colon, 6 cm. in length and apparently normal, projects beyond the confines of the tumor.

The walls of the bowel are infiltrated by tumor, reaching a thickness of 1.5 cm. Masses of tumor tissue also project into the lumen of the bowel, almost totally occluding it. In fact, it was found that water poured into the cæcum could not without great difficulty be forced through the tumor area.

The tumor sections with the resistance of fibrous tissue and is very firm. It is everywhere covered by intact mucosa, there being no evidence of ulceration or necrosis. Its cut surface has a grayish-white, glistening appearance. A few firm, enlarged lymph nodes are present in the neighboring mesentery and mesocolon. The appendix measures about 8 cm. in length and is apparently normal.

Microscopically, the tumor is composed of a very cellular connective tissue stroma in which are varying sized groups of strands and bundles of fibrils with many rounded and oval nuclei of varying size. Thin-walled capillaries are abundant. The tumor tissue invades the submucosa and lies immediately adjacent to the mucous membrane. There are a few microscopic areas of necrosis. In some portions connective tissue fibrillæ are almost entirely absent and large numbers of rounded nuclei with irregular masses of chromatin are present. Alongside of some of these cells tiny fibrillæ may be distinguished by special stains. Mitotic figures are fairly common. Numerous eosinophiles and lymphocytes infiltrate the tissue spaces.

Miscroscopic examination of one of the adjacent swollen lymph nodes shows the node invaded by tissue resembling in every respect that found in the parent tumor.

Diagnosis.—Round-cell sarcoma of cæcum and ascending colon with metastasis to neighboring lymph node.

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NON-ROTATION OF THE INTESTINE.*

ITS RELATION TO HIGH, RETROCÆCAL AND ABERRANT POSITIONS OF THE APPENDIX.

BY ARTHUR SEYMOUR VOSBURGH, M.D.,

OF NEW YORK.

The frequency with which one meets, in operating, the abnormally placed appendix, and the difficulties encountered in dealing with it, often through a badly placed incision, seem to warrant a review of the subject.

The most frequent variation is the " retrocæcal " appendix. By this I mean an appendix actually extraperitoneal, in whole or in part, by reason of secondary adhesion in the process of development, and not extraperitoneal as a result of segregation by a protective peritonitis.

Rarer forms are those where we find the appendix in the region of the liver, approximating the median line, or in the left iliac fossa. In these latter, more advanced forms of arrest of development, we are apt to find the ileum entering the cæcum on the right side.

The difficulties of these cases are further increased by failure in early diagnosis. They come to the hospital late through lack of prompt recognition, or we, beset by the same difficulties of diagnosis, fail to give the prompt relief demanded. We have in consequence to deal with an inflammation far advanced, with bowel and mesentery unduly thickened, rendering the gut difficult of manipulation.

The extraperitoneal retrocæcal forms fail to give us the telltale symptoms of peritoneal involvement, with its characteristic rigidity of the adjacent abdominal wall.

Some of us have observed cases of well advanced peritonitis, where we have failed to elicit the symptom of abdominal rigidity. On opening the abdomen in such a case, the explanation has been found in the fact that the inflammation has been confined chiefly to the visceral and mesenteric peritoneum.

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* Read before the New York Surgical Society, October 9, 1912.

Dr. Charles N. Dowd has recently emphasized this symptom in an article in the *American Journal of Surgery,* June, 1912, entitled "Some Peculiarities of Deep-Lying Abdominal Inflammation." He summarizes as follows: The parietal peritoneum, supplied through the peripheral nervous system is rich in sensation, while the visceral peritoneum, deriving its nerve supply from the sympathetic system has no nerves sensitive to pressure, heat or cold.

The failure of deep-seated appendicitis to conform to the classical train of symptoms, which renders diagnosis comparatively easy, and the mistakes into which I fell, by this same failure, aroused my interest in this subject.

Among my private and hospital cases of appendicitis I find ten of abnormally placed appendix. Nine retrocæcal, and one where the appendix abscess was in contact with the liver. This last I will describe in detail.

Case.—Albert K., son of Italian parents, five years old, was admitted to the first surgical division of Bellevue Hospital on August 1, 1912. Nine days before was taken sick with pain in the upper abdomen. Vomiting kept up all the first night. A private physician gave him some medicine which relieved him for the time being. Two days before admission pain became worse, and he was confined to the bed. Pain was of a cramplike character. Bowels moved daily. On admission, temperature 103°, respirations 28, pulse 140, leucocytes 4300, polynuclears 85 per cent. Tenderness over whole of right side. Right rectus held rigid. Abdomen not distended. Maximum rigidity, right upper quadrant.

Diagnosis, high appendicitis.

Operation (August 1).—Right rectus incision above level of umbilicus. Transverse colon presented in the wound. This and parietal peritoneum seemed normal. No free fluid. On further examination a mass was felt in contact with the liver, which on investigation proved to be an appendix abscess walled in by the cæcum and the ascending colon. The cæcum was bent on the ascending colon in the form of the capital letter J. Cæcum to the right of ascending colon, parallel to it, and pointing to the liver. The appendix, gangrenous, lay in the sulcus formed by the cæcum and ascending colon. Small intestine lay behind these structures, whether duodenum or a coil of the ileum, I was unable to determine. The gut was so thickened and infiltrated that it was impossible to treat the remnant of appendix other than by the introduction of cigarette drains to the bottom of the abscess cavity. A foul discharge continued for several days, and it was feared that a fecal fistula would develop. Fortunately this did not occur. Pathological report on the small piece of appendix we were able to remove was gangrenous appendicitis. An X-ray of the colon was obtained subsequent to his recovery (Fig. 1).

A detailed description of the retrocæcal cases is not necessary, except to emphasize the difficulty in early diagnosis, for the reasons above stated.

Dr. Charles H. Mayo (*Medical Record,* March 2, 1912) reports five cases of ascending colon on the left side, or approximating the median line. Three were operated upon for left-sided appendicitis. Two with acute abscess.

From this brief review it will be seen that this condition of abnormally placed appendix, while not common, does confront us in a certain small percentage of cases.

The correct interpretation of these various positions of the appendix is only possible, by a study of the embryology of this part of the intestinal tract. Each of these positions of the intestine, which we think of as abnormal, has some stage of embryological development, or some prototype in comparative vertebrate anatomy, as its explanation.

While it is impossible to trace each step of development in human embryology, yet by the aid of comparative anatomy, we are able to follow the picture with great surety.

The earliest indication of the alimentary tract is that of a straight tube attached to the axial mesoderm by a dorsal mesentery. From this primitive mesentery all the other mesenteries, omenta and peritoneal folds of the adult are derived by further development, displacement and adhesion, with the exception of the anterior mesogastrium. The anterior or ventral mesogastrium is the remnant of the mesothelial layers, which extended between the ventral abdominal wall and the ventral border of the intestine, just after the splanchnopleure and the somatopleure have closed to form the alimentary tube and the body cavity. This primitive partition is lost below the stomach.

The intestine in the very earliest stage follows the body curve, later a loop is seen projecting toward the umbilicus where, by means of the vitello-intestinal duct, it communicates with the yolk-sac. We distinguish a descending limb and an ascending limb.

The cæcum bud appears about the sixth week. It shows an unequal rate of growth. The terminal piece not keeping pace with the proximal portion forms the appendix. The proximal portion is developed into the cæcum proper. Owing to its rapid growth the ascending limb of the loop, which forms the major portion of the small intestine, is thrown into folds. This very rapid growth of the small intestine forces the slow growing large intestine into the line of least resistance, *i.e.*, toward the median line and the ventral abdominal wall, forcing it gradually upward toward the cephalic end of the abdominal cavity. This occurs about the end of the third month. At the fourth month the cæcum moves to the right, touches the caudal surface of the liver ventrad of the duodenum. The rapid growth of the liver during the placental stage of its circulation, forces the cæcum caudad, past the right kidney to its adult position in the right iliac fossa.

This progression of the cæcum and ascending colon from below upward, from left to right, and finally downward, is accomplished by the twisting, of all the gut and mesentery embraced in the umbilical loop, on its duodenocolic isthmus, or on an axis running from the umbilicus to the superior mesenteric artery. The cæcum and the ascending colon under the pull of the small intestine, has undergone a rotation on its long axis of a hundred and eighty degrees. This is well shown by tracing the muscular longitudinal bands of the ascending colon into the transverse colon.

Take for example a piece of rubber tubing to represent the ascending and transverse colon. Place upon it three lines to represent the longitudinal bands of the intestine. Let them be marked distinctively, so that, in whatever way you twist the tube, they may be distinguished, one from another. The attached, posterior, or mesenteric border of the embryonic gut is the site of the " posterior band."

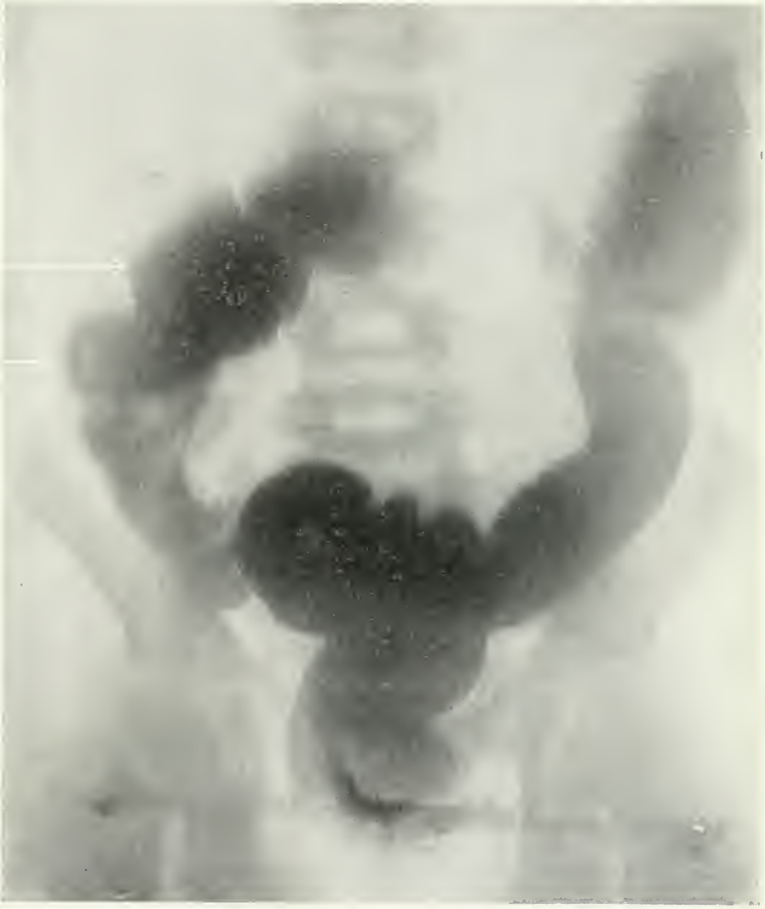
Hold the portion of the tube, which we have denominated transverse colon, in the anatomical position, the posterior longitudinal band cephalad; the so-called " anterior band " will lie ventrad, and the " inner band " will lie dorsad.

Bend the tube at what would be the hepatic angle, and twist that portion representing the ascending colon on its long axis, from left to right through one hundred and eighty degrees. It will be found that the longitudinal bands will assume the position we call normal in the ascending portion of the colon. The " anterior band " external, the " inner band " anterior and internal, the " posterior band " posterior and internal. The right leaf of the ascending colon unites with the parietal peritoneum on the right side, and the left leaf of the descending colon unites with the parietal peritoneum on the left side of the abdomen. In this way the normal adult type of peritoneal arrangement is brought about.

The accompanying illustrations (Figs. 2–10), kindly loaned me by Professor George S. Hutington, from his volume on The Anatomy of the Peritoneum, will better illustrate the points in development.

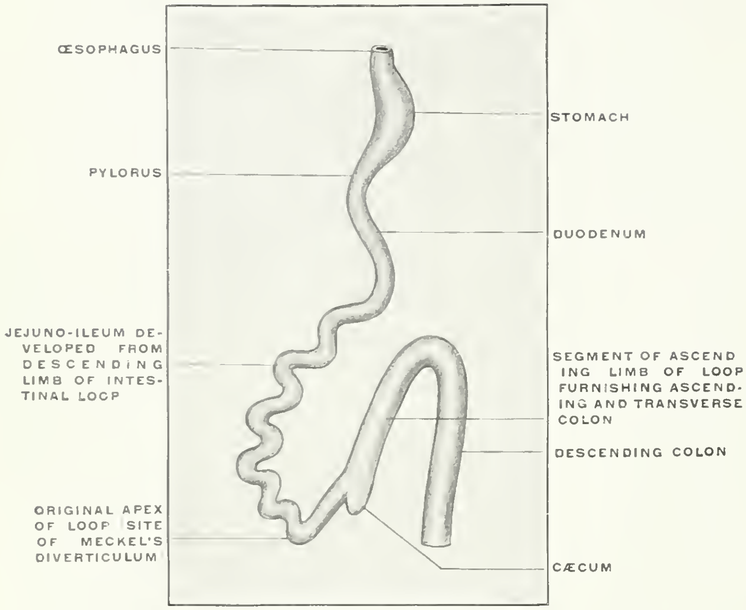
From a review of these figures we see we can derive all the forms of abnormally placed appendix. Arrest of development may halt the cæcum and ascending colon at any point in its progression from left to right. Failure of the intestine to rotate on its duodenocolic isthmus leaves the colon to the left

Fig. 1.



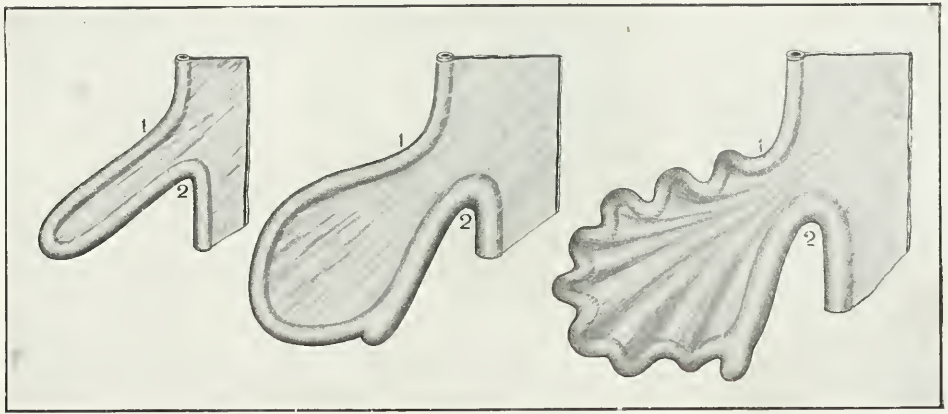
Long arrow points to cæcum. Short arrow to coils of small intestine.

FIG. 2.


ŒSOPHAGUS
STOMACH
PYLORUS
DUODENUM
JEJUNO-ILEUM DEVELOPED FROM DESCENDING LIMB OF INTESTINAL LOOP
SEGMENT OF ASCENDING LIMB OF LOOP FURNISHING ASCENDING AND TRANSVERSE COLON
DESCENDING COLON
ORIGINAL APEX OF LOOP SITE OF MECKEL'S DIVERTICULUM
CÆCUM

Schema of human embryonic intestinal canal after differentiation of large and small intestine.

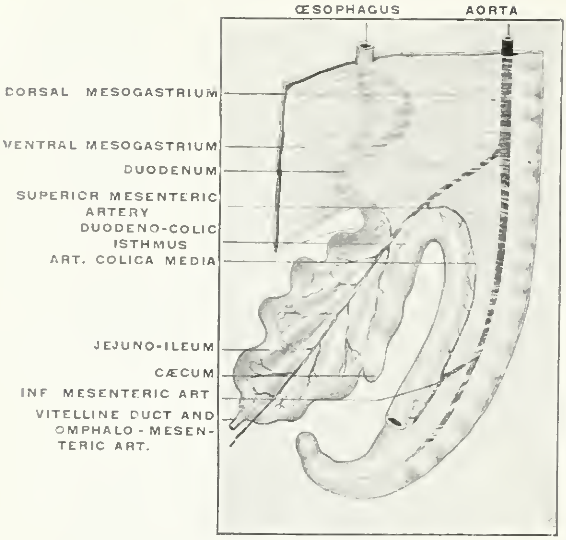
FIG. 3.



I. II. III.

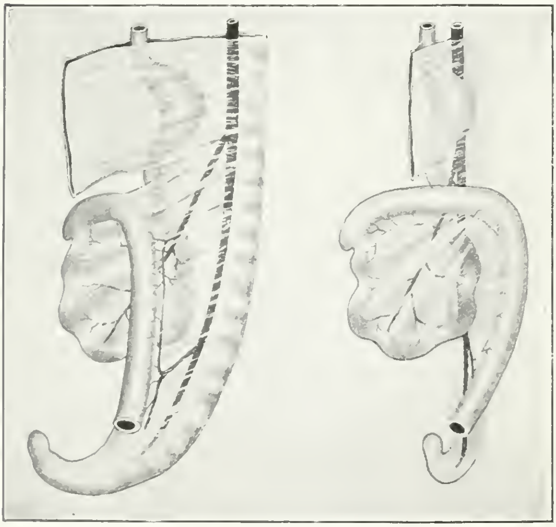
Schematic representation of the development of the mesentery of the umbilical loop.

Fig. 4.



A

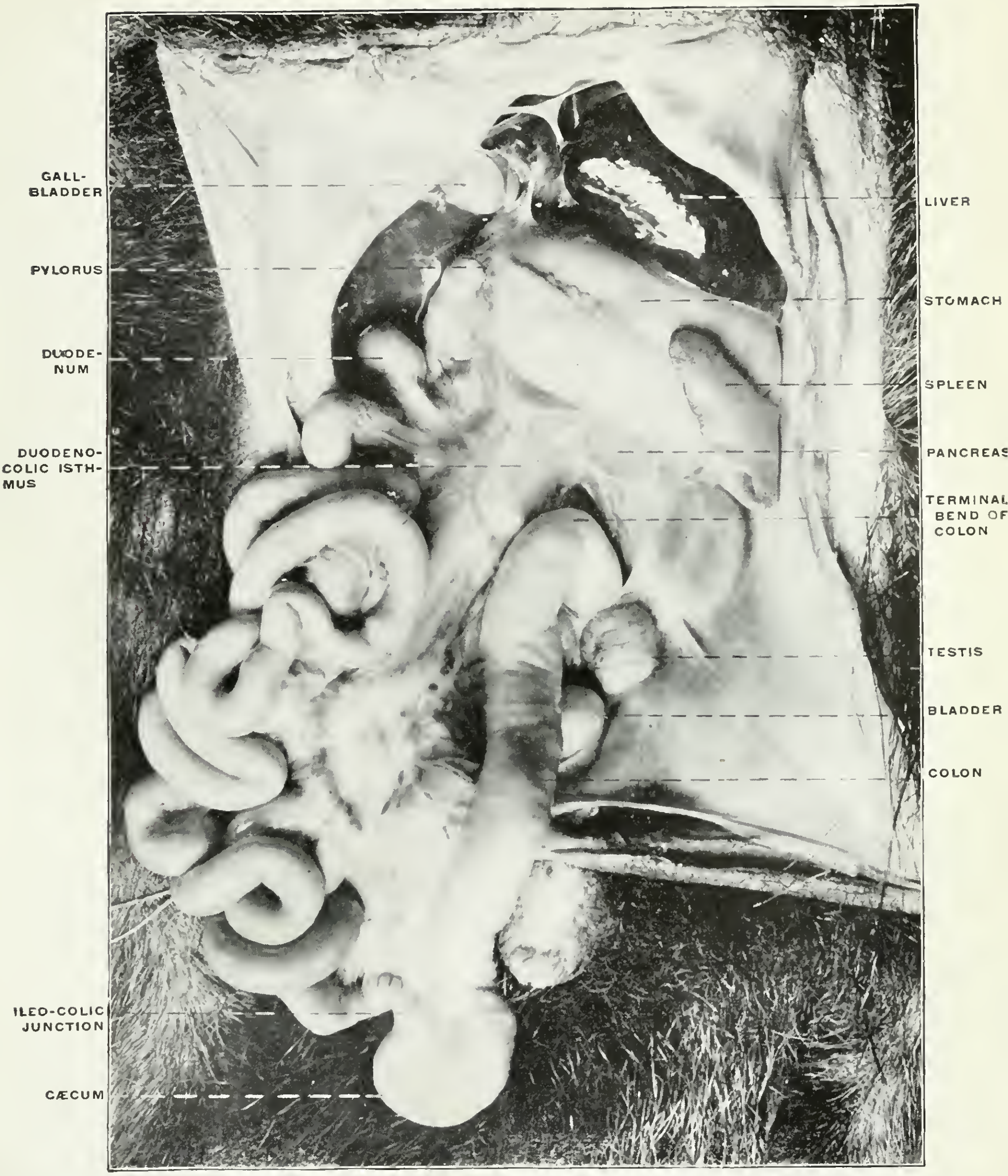
Schematic representation of alimentary canal, with umbilical loop and mesenteric attachments in human embryo of about six weeks.



B C

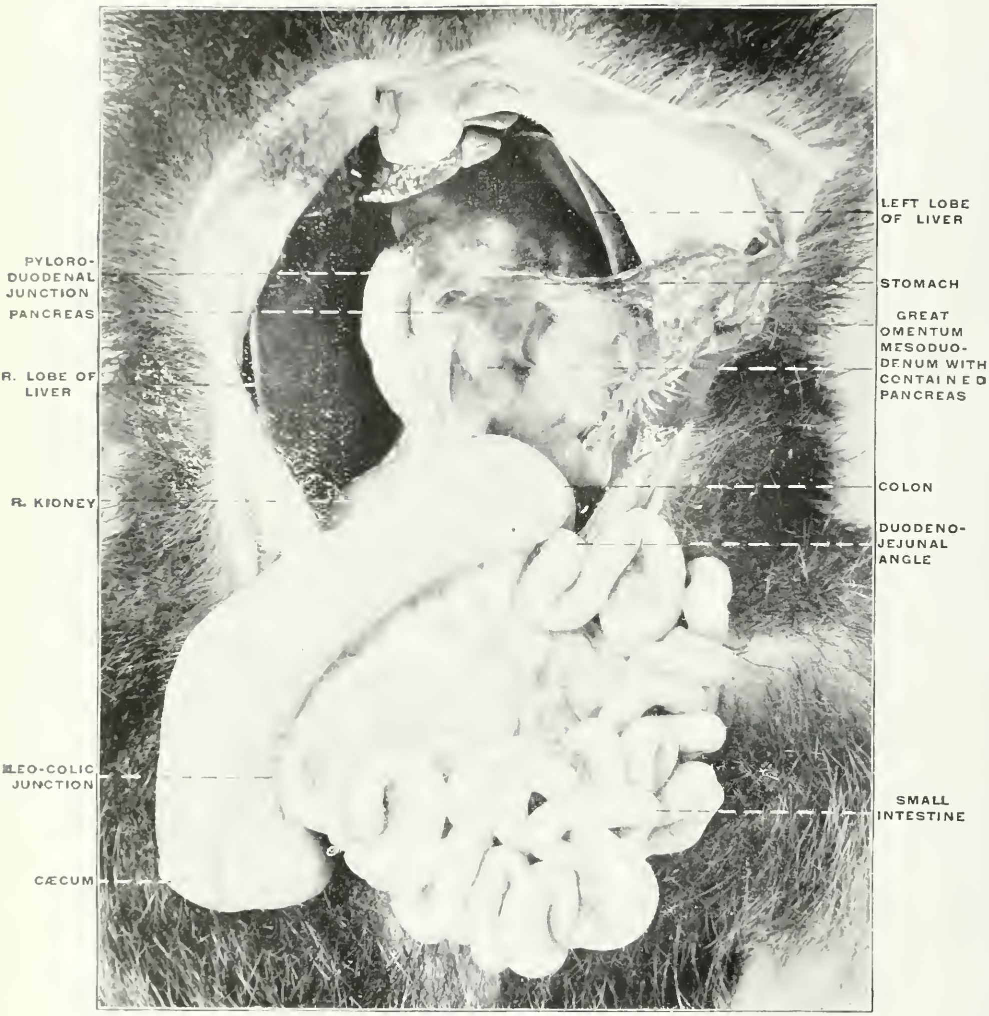
Stages in intestinal rotation.

Fig. 5.



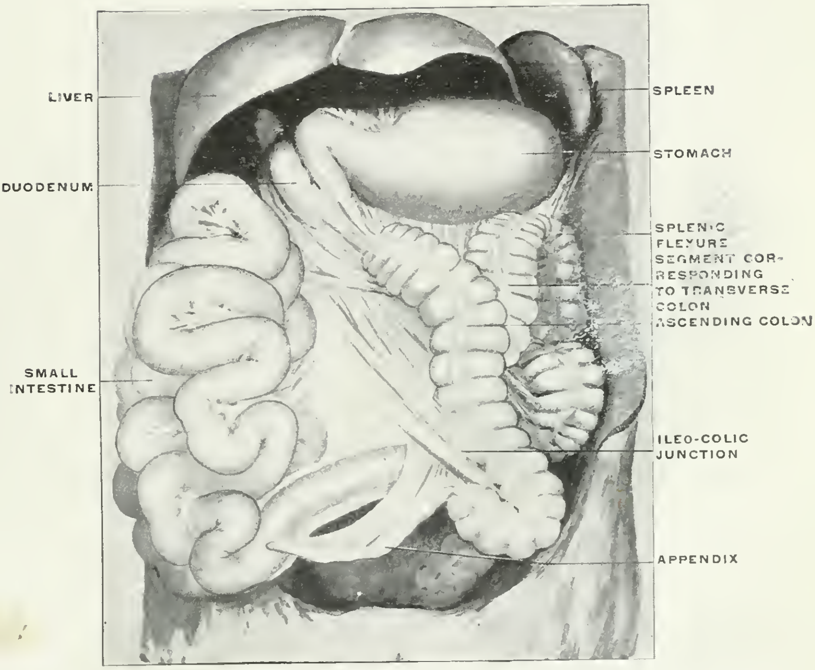
Abdominal viscera of the little ant-eater, seen from the left, with the intestines turned to the right.

Fig. 6.



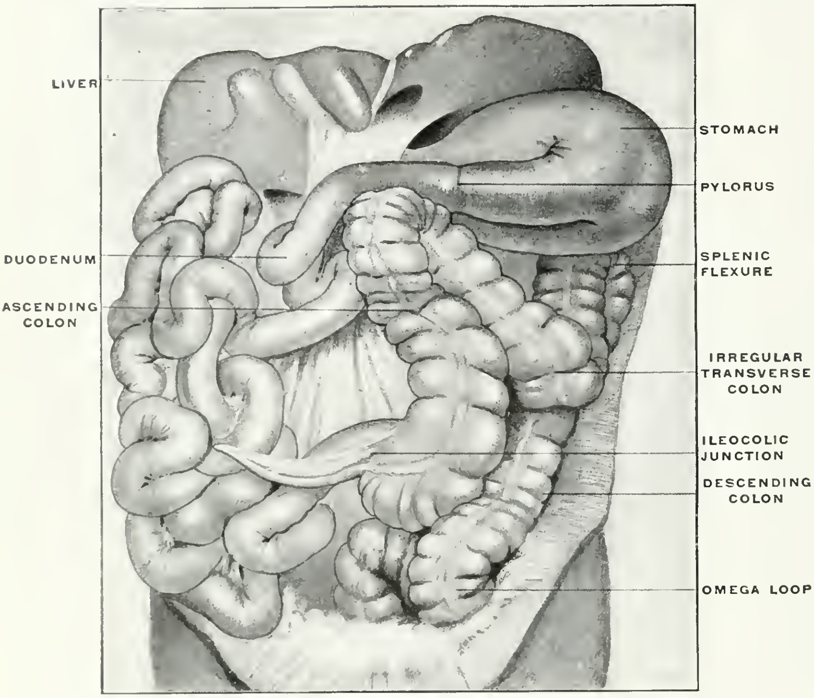
Abdominal viscera of the little ant-eater with the intestines rotated to correspond to the development in the human subject.

Fig. 7.



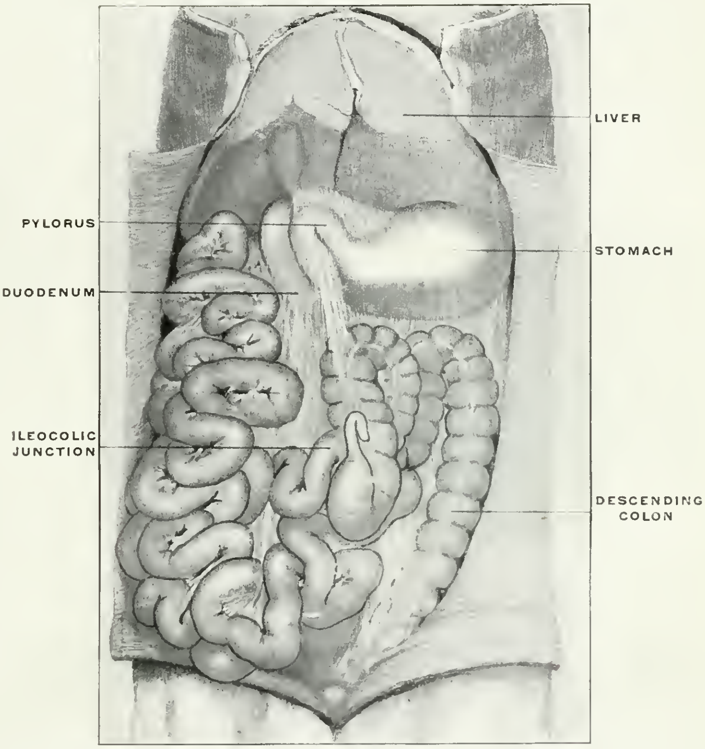
Abdominal viscera of adult human female, in a case of arrested rotation of the intestines.

Fig. 8



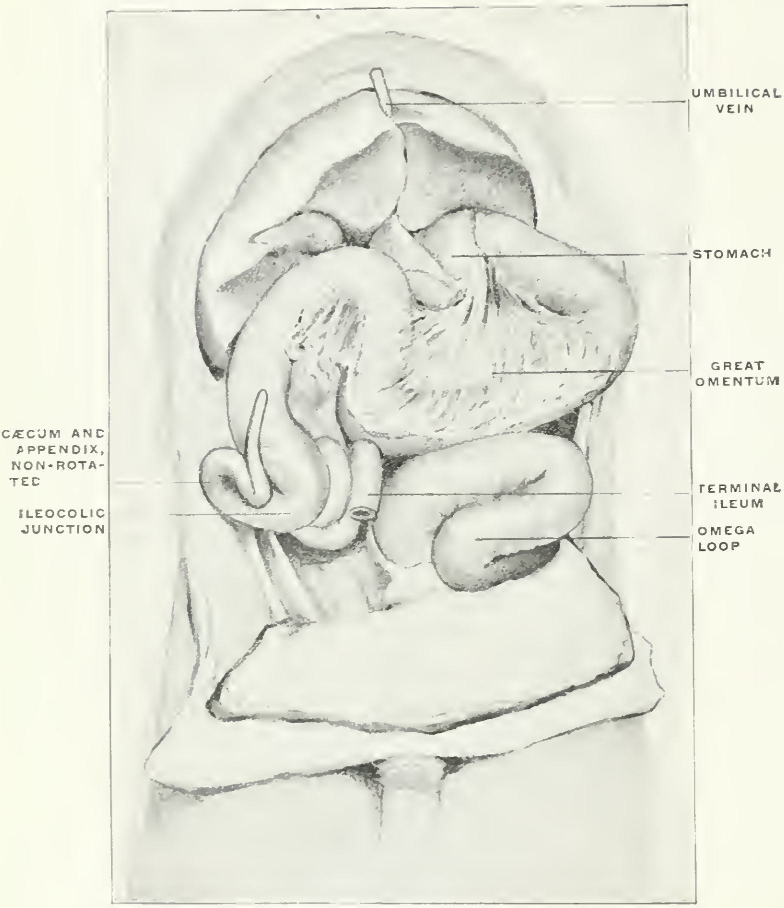
Abdominal viscera of adult human male, non-rotation of intestine, ileum entering on the right side of cæcum.

Fig. 9.



Abdominal viscera of a child, two years old; non-rotation of intestine. Ileocolic junction on right side, appendix almost in the median line.

Fig. 10.



Human fœtus at term; abdominal viscera hardened *(in situ)*; non-rotation of cæcum.

and small intestine to the right. A partial failure of this rotation, the small intestine having failed to withdraw all of its coils from behind the cæcum, will leave the appendix in a retrocæcal position, there to become buried by subsequent adhesion.

CONCLUSIONS.

The unusual and aberrant positions of the appendix have for their explanation, a stage of embryological development, there arrested; or an evidence of atavism to some prototype in comparative anatomy.

The clinical findings, in the case mentioned above, are of value as supplementing anatomic and post-mortem findings.

The approach to the appendix, in the retrocæcal types, after the abdomen has been opened, is best accomplished by an incision along the right side of the ascending colon, thus mobilizing the cæcum.

A RETRORECTUS LAPAROTOMY INCISION AND CLOSURE.

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OF NEW YORK,

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In gaining access to the lower abdominal cavity numerous incisions have been planned with the dual object of attaining: (1) Requisite exposure with a minimum of structural damage; and (2) protection against subsequent hernia.

The McBurney "gridiron" or muscle-split incision deservedly holds a prominent place in this type of procedure; but because this had a limited application, entrance has been sought through the split fibres of the rectus muscle (Deaver incision), or at the outer margin of the muscle (Battle-Jalaguier-Kammerer incision).

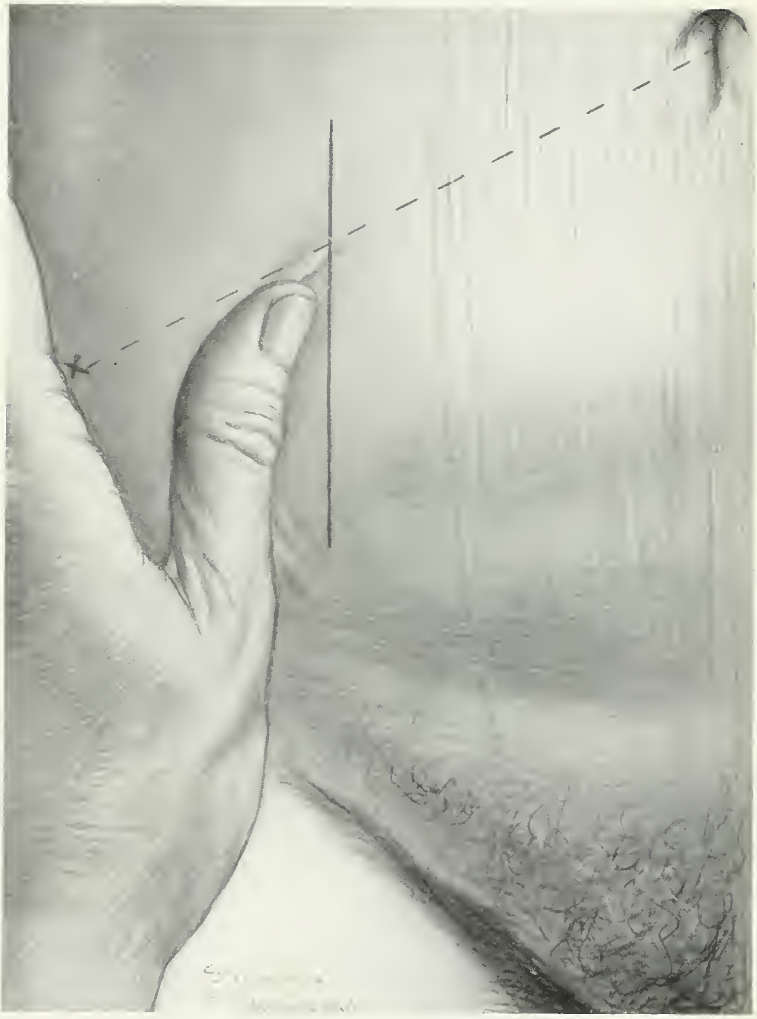
At the present time it is a growing custom to perform median oftener than lateral laparotomy, because experience has shown that multiple rather than suspected single lesions often exist. This is notably true of appendicitis where other pathological conditions are often found, such as membranous pericolitis, kinks, mobile cæcum, ureteral, tubal and ovarian lesions.

It is my observation that laparotomies are more than ever in a real sense "exploratory," and for that reason lateral incisions are being much more limited and will probably soon be reserved for appendicitis in children or where abscess is apparent.

The transrectus incision (Deaver) is sometimes unsatisfactory because the muscle is often torn or bruised; and also because the deep epigastric vessels are so commonly cut necessitating delay at a stage when it is especially aggravating.

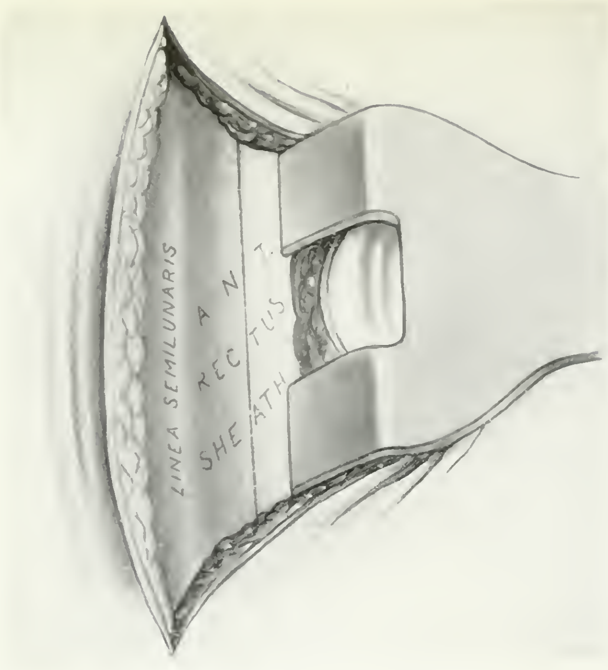
Lateral and retrorectus incisions are theoretically faulty in that the nerve supply to the rectus is in part cut, thus predisposing to hernia; however, the adequacy of exposure and the possibility of interposing the entire intact muscle between the

Fig. 1.



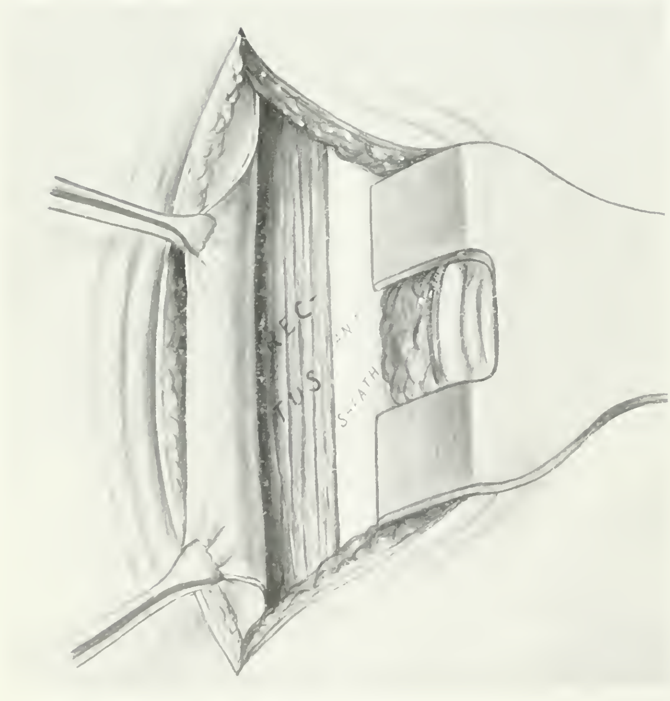
Skin retracted outward and line of incision as for appendicitis.

Fig. 2.



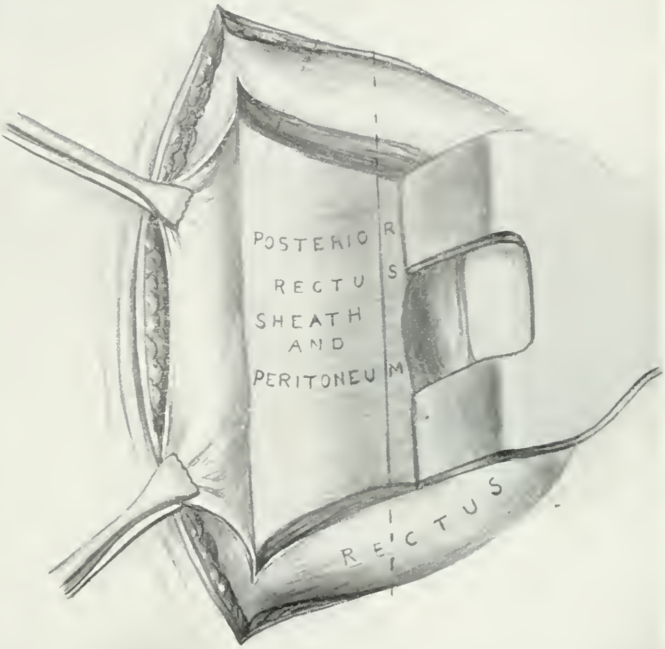
Line of incision in anterior rectus sheath.

Fig. 3.



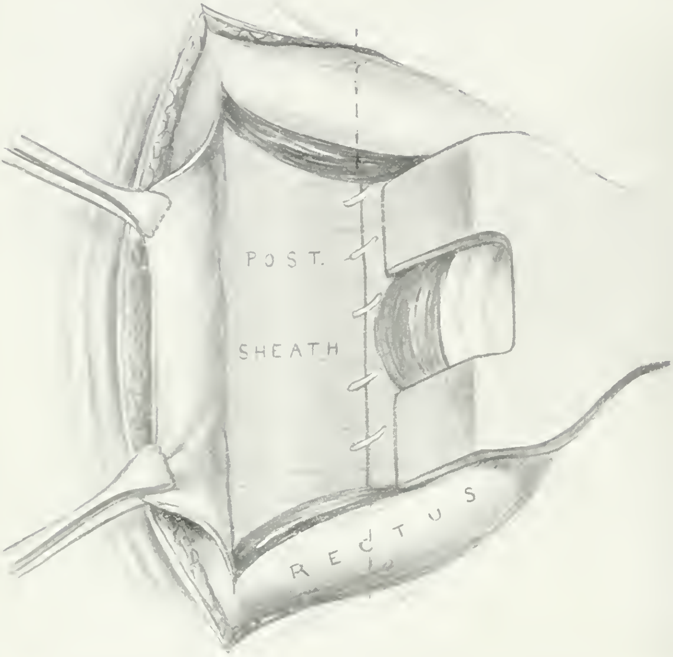
Outer portion of sheath dissected outward to the shelving edge.

FIG. 4.



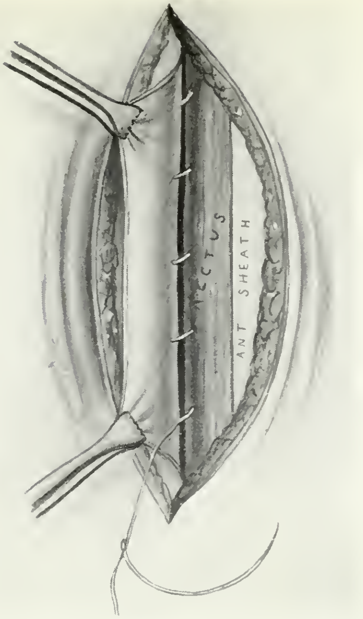
Line of incision in posterior sheath and peritoneum.

Fig. 5.



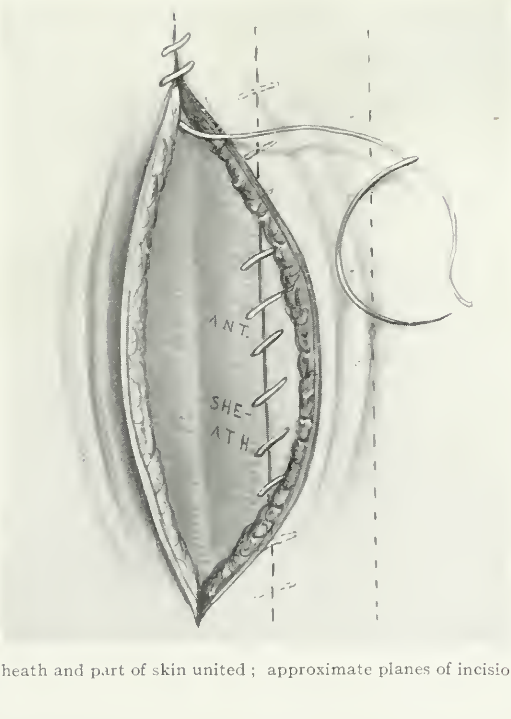
Posterior sheath and peritoneum united.

FIG. 6.



Outer edge of intact rectus united to shelving edge of anterior sheath.

FIG. 7.



Anterior sheath and part of skin united ; approximate planes of incisions shown.

incisional planes to a great extent modifies this technical objection.

During the past two years the retrorectus incision and closure to be described have been used in practically all low laparotomies by the writer, and a description of it is offered because it appears to provide an easy and adequate approach with little traumatism, and to a great extent should protect against subsequent hernia. In addition to the stairway planes of the incisions, a method of closure of the second layer is also presented, this resembling a similar step in inguinal herniotomy (Bassini).

Technic.—The abdominal wall is rendered tense by pulling the skin toward the anterior iliac spine. A vertical incision is made of the desired length (usually three inches), two and a half or three inches from the median line, and it is deepened until the anterior rectus sheath is seen (Fig. 1).

The taut skin is then allowed to fall into place.

The anterior rectus sheath is nicked at a point one-half inch or more internal to the line of the skin incision and it is then incised to the length of the skin wound. This incisure is at least one-half inch within the linea semilunaris (Fig. 2).

The outer portion of the anterior rectus sheath is then dissected bluntly from the muscle until the attachment to the linea semilunaris appears, and here the junction will be found to resemble the " shelving edge " of the external oblique fascia at Poupart's ligament. The intact rectus muscle is thus exposed at the outer margin. The remaining inner portion of the anterior rectus sheath is undisturbed (Fig. 3).

The entire intact muscle is now retracted toward the median line and this often brings the deep epigastric vessels into view; they should not be damaged, but when caused to bleed immediate ligation is made (Fig. 3).

The posterior rectus sheath, areolar tissue, fascia and peritoneum, as one layer, are incised as nearly behind the middle of the rectus muscle as retraction and the needs of the operation permit (Fig. 4).

Closure.—Peritoneum-fascia is united by a continuous catgut suture (Fig. 5). The outer edge of the rectus muscle is united by continuous catgut sutures to the exposed shelving edge of the under surface of the anterior rectus sheath, previously dissected to the semilunaris (Fig. 6).

The anterior rectus sheath is joined by a continuous catgut stitch (Fig. 7). The skin is united by catgut, linen, silk or favorite material (Fig. 7). If desired, one continuous suture may be used for several or all layers.

Where drainage is required, a suprapubic or supra-inguinal opening is provided.

It will be seen that the *incisions* divide practically three structural layers; namely, skin, anterior rectus sheath, and fascia-peritoneum, the intact muscle intervening.

The *closure* is in four layers, and the important anterior rectus sheath is doubly united.

The *planes of incision* are respectively two and one-half (skin), two (anterior rectus sheath), and one and one-half inches (fascia-peritoneum) from the median line; this proportion obviously may vary slightly within narrow limits.

This technic is presented not so much with the idea of being novel, but because it appears satisfactory for the following reasons:

1. Adequate and rapid exposure without undue traumatism to intervening layers or vessels.

2. Prolongation of the original incisional lines is readily accomplished when needed.

3. The rectus muscle and its blood supply are undamaged and very little bleeding occurs.

4. Closure in four non-superimposed layers adequately guards against hernia, notably because of the interposed intact rectus and the plication of it to the shelving edge of the anterior sheath.

5. The double line of suturing in the anterior rectus sheath should to some degree compensate for the apparent damage inflicted upon the nerve supply, a vice inherent to all similar vertical incisions.

The same principle and "stairway" type of incision may be followed by pulling the skin *toward* the median line instead of *away* from it.

THE ANATOMY OF A CASE OF CARCINOMA RECTI.

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OF CLEVELAND, OHIO,
Henry Willson Payne Professor of Anatomy in the Western Reserve University.

In many instances practical anatomical studies in relation to clinical work have been and are being made by clinical men, anatomists as a rule confining themselves to the morphological aspect of their science. While this is quite a natural state of affairs it seems unfortunate that such a profusion of material as must present itself in the dissecting room of any large medical school, should remain unutilized. The case of carcinoma recti which is described in the present communication was found in the dissecting room of this school during the past winter session and stimulated the observations here put forward. It was my privilege to be assistant to Professor J. W. Smith, of Manchester, Eng., at many operations for resection of the rectum by his perineal method. The principles on which this operation is based have been published elsewhere[1], [2]. These principles were formed as a result of our dissections of the normal cadaver in addition to the large operative experience of Mr. Smith. Having now had the opportunity of dissecting a typical case of carcinoma recti it is possible to discuss the anatomical facts which must be considered in relation to the diseased organ. It is to be understood that present comments refer more particularly to carcinoma occurring in the ampulla of the rectum or in the region of the great third valve of Houston as indicated in Fig. 1. This portion of the organ is better termed the perineal chamber.[3]

The problems of greatest importance in connection with resection of this portion of the gut, and which, at the same time are capable of illumination from the anatomical standpoint may be stated briefly as:

1. The directions of permeation of the cancer cells.
2. The vascular supply of the gut subsequent to operation.

3. The manner in which the rectum is normally held *in situ.*

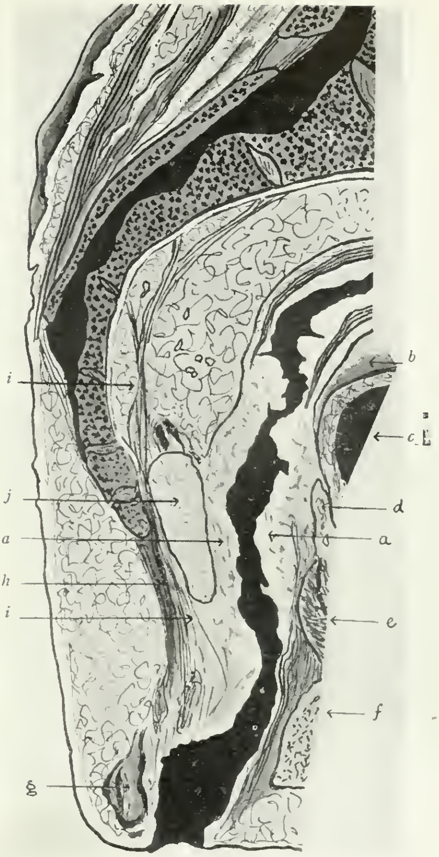
It is generally accepted that lymphatic extension occurs late in this disease except in the pararectal glands (anorectal glands of Gerota), in the immediate efferent trunks which follow the course of the hemorrhoidal vessels, and in those lymphatic channels which eventually open into the inguinal group of glands. The present case bears out the above view. As may be seen from Fig. 1, the original growth occurs in the perineal chamber and in addition a large fistulous ulcer with undermined walls and sloughy base lies on the left side of the anal canal. Fig. 2 illustrates the condition of the inguinal glands. The pararectal glands are numerous and large but all enlarged glands are on the inner surface of the so-called pelvic fascia. None are to be found between the pelvic fascia and the sacrum. No infected glands are found above the sacral promontory and the liver shows no metastasis in spite of the advanced stage of disease.

A considerable portion of the tumor occupies the anterior wall of the ampulla and is fixed to the prostate. There is, however, no involvement of the latter organ. The posterior portion of the sheath of the prostate is thickened and consists of very dense fibrous tissue. But it was a simple matter to free the prostate from the infected area.

As the lymphatic tracts along which the carcinoma may permeate, with the exception of those along the superior hemorrhoidal vessels, leave the lower portion of the perineal chamber and progress along middle and inferior hemorrhoidal vessels and also toward the inguinal glands, it is obvious that the possibility of widespread growth is more likely if the primary tumor is situated low down than when it is in the region of the great valve of Houston.

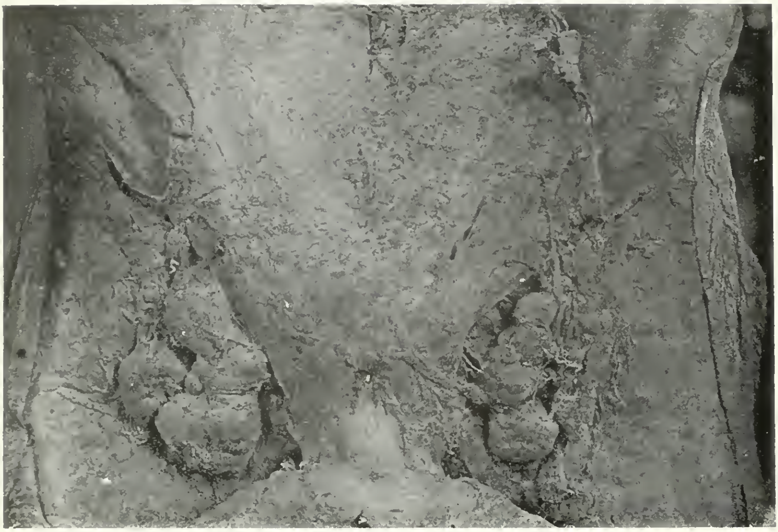
The fact that all enlarged glands in the pelvis were found between the rectum and the layer of visceral pelvic fascia lying between rectum and sacrum, is important. For during operation, if resection of rectum and this fascia be done in one piece, all the involved glands will be effectually extirpated without surgically soiling the remaining tissues of the pelvis. The

FIG. 1.



Carcinoma recti in patient aged sixty-two. Left face of mesial anteroposterior section of pelvis. The clinical notes and diagnosis received give no information respecting the condition. *a*, site of carcinoma in rectum; *b*, pouch of Douglas; *c*, bladder; *d*, seminal vesicle; *e*, prostate; *f*, bulb of urethra; *g*, fistulous ulcer; *h*, levator ani; *i*, rectosacral aponeurosis; *j*, carcinomatous pararectal gland. It is to be noted that though the infected gland shown in the figure lies just above the levator ani, it is separated from the latter by the rectosacral aponeurosis. This fascial sheath for the rectum and pararectal glands is very well marked in the specimen from which the drawing was made and shows clearly its attachment to the sacrum. The only successful manner of taking out rectum and pararectal glands in one piece is to dissect from below, passing the hand between levator ani and rectosacral aponeurosis and next between the latter and the sacrum. The numerous sacral attachments of the aponeurosis render it impossible to satisfactorily perform this manœuvre from above. The muscle and aponeurosis lie in immediate relation with each other in the present case, but could easily be separated.

FIG. 2.



Photograph of inguinal region to show the enlarged glands present in association with the carcinoma and fistula.

fascia referred to, may, following Smith's lead, be termed *rectal fascia* or *rectosacral aponeurosis.*

Local extension to the sacrum usually occurs by permeation along the course of the middle hemorrhoidal artery and sacral nerves in the tissue of the rectal stalk, which will be mentioned later. Local extension forward to the prostate or female genital organs is always preceded, as in this case, by preliminary fibrosis, which may lead to the suspicion of involvement by growth. But examination under anæsthetic frequently decides this point. In all male cases a sound passed through the urethra is of advantage in fixing anatomical landmarks.

As regards its lymphatic arrangements, the rectum is termed by Smith a "self contained" organ.[2] If it can be excised together with the rectal fascia in one piece, the probability of recurrence is greatly reduced.

In order to successfully perform this operation it is essential to dissect the organ out by the perineal route (see attachment of rectal fascia to rectum (Figs. 1, 3, 4).

The relation of the rectal lymphatic chains to those of the pelvic colon will be mentioned in the next section.

As regards the vascular supply of the rectum the researches of Hartmann[4] and Davis[5] have shown that there is no anastomosis between terminal vessels on the wall of the gut. This is a particular instance of a general principle carried out through the whole length of the intestine, small and large. The usual arrangement of anastomotic channels is diagrammatically shown in Fig. 3 made from a dissection carried out in Manchester. Hartmann's "critical point," the anastomosis between the superior hemorrhoidal and distal sigmoidal arteries, is marked by an asterisk and lies 1 to 1.5 cm. below the sacral promontory and somewhat to the left of the mid-line.

As Davis observes, it is impossible to be sure of ligaturing the superior hemorrhoidal vessel above this point and so maintaining the integrity of the vascular supply of the terminal piece of gut which is sutured to the perineal skin, if the operation is performed by the perineal route. But Riese pointed out that even by the abdominal incision in the combined method of operation it is not feasible to determine the proper point for safe ligation.[6] Sudeck has even gone so far as to suggest ligation of the inferior mesenteric artery.[7] The occurrence of gangrene subsequent to operation, even after elaborate precautions have been taken to preserve the blood supply, suggests the necessity of some further modification of technic.

The anastomosis between proximal and distal sigmoid arteries is maintained by the vascular loop shown in Fig. 3. If, therefore, part of the distal limb of pelvic colon be removed with the rectum, so as to encroach with certainty upon the area of supply of the sigmoidal arteries, there will be less danger of subsequent gangrene. The plan of excising part of the distal limb of the pelvic colon has further recommendation. It ensures removal of a portion of the mesosigmoid which might possibly be infected by retrograde permeation by cancer cells. It allows removal of any length of bowel from the anus upward to approximately 14 inches, 18 in subjects with a long mesentery to the pelvic colon, and would meet in large measure the requirements of Sampson Handley[8] and of Miles.[9] In the

FIG. 3.

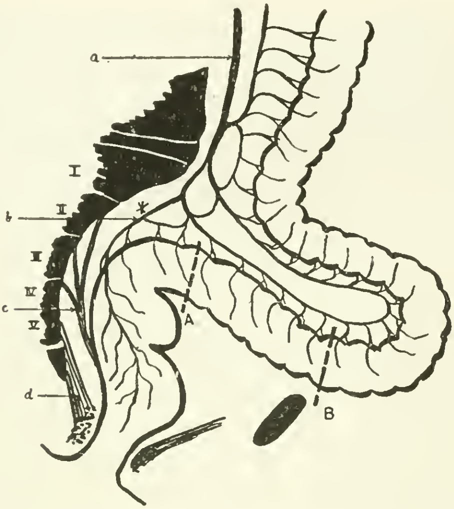
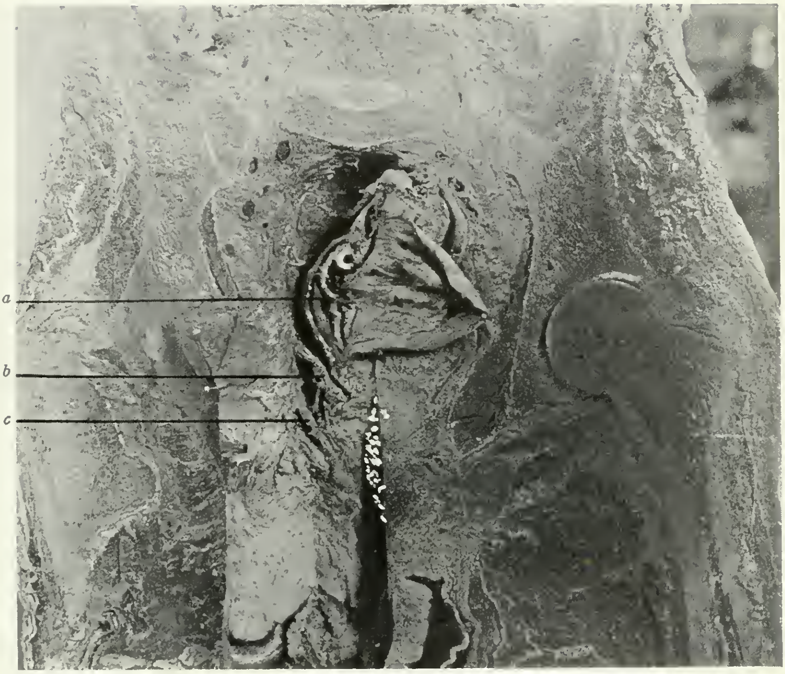


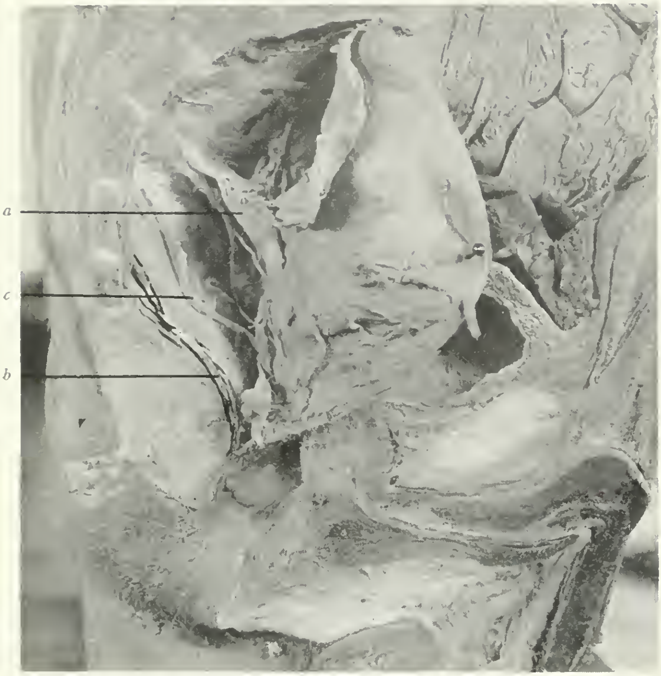
Diagram of vascular supply to the pelvic colon and rectum. The asterisk marks Hartmann's point. *A*, line of section in Krogius' operation; *B*, line of section in Smith's operation and area of gut sutured into perineal wound in both methods of procedure; *a*, inferior mesenteric artery; *b*, superior hemorrhoidal artery; *c*, rectosacral aponeurosis; *d*, levator ani.

FIG. 5.



Photograph of vertical transverse section through the diseased pelvis to show dissection of levator ani and rectosacral aponeurosis on the right side. The white stippled area represents the site of the growth. The peritoneum of the pouch of Douglas is pinned out of the way. *a*, right terminal branch of superior hemorrhoidal artery, passing along the line of peritoneal reflexion from rectum; *b*, rectosacral aponeurosis (rectal stalk); *c*, levator ani.

FIG. 4.



Left face of anteroposterior mesial section through a normal adult male pelvis. The rectum has been pinned forward to show the attachment of the rectosacral aponeurosis to the sacrum. *a*, rectosacral aponeurosis; *b*, levator ani; *c*, nerve to levator ani.

operation performed by Krogius of Helsingfors this distal portion is left *in situ,*[10] but in Smith's operation it is removed (see Fig. 3).

The anatomical researches of Homen and Wallgren[11] show that in almost all cases the mesentery of the pelvic colon is long enough to allow some part of the loop to be sutured to the anal skin without tension. Certainly in Mr. Smith's experience the excision of the distal portion of the colon along with the rectum has always been successful. Gangrene has never occurred[2] although, as was to be expected, in certain cases the pelvic colon did not come down into the perineal wound as easily as in others.

The removal of the distal portion of the pelvic colon along with the diseased rectum does not increase the operation mortality, a result contrary to continental experience. Moreover, if this procedure be adopted, there is no risk of recurrence in the anal region, a complication, which as Sampson Handley has pointed out, is liable to occur if less bowel be removed.[12]

The third anatomical consideration is that of the normal support of the rectum. In spite of the knowledge that the uterus is upheld by the perivascular and perineural tissue of the broad ligament, especially by the basal portion surrounding the sacral nerves (known as the ligament of Mackenrodt), it is not generally realized that the rectum is supported in precisely the same manner. The levator ani has but little importance as a rectal support. When perineal excision of the rectum is undertaken, the levatores ani may be severed, but that does not result in the cutting adrift of the gut. One cannot draw it down and out through the wound. Between the levator ani and sacrum posteriorly and the rectum anteriorly is a mass of tissue termed by Smith the rectosacral aponeurosis. It connects the lower part of the perineal chamber of the rectum with the sacrum at the level of the third or fourth piece. On dissection this mass of tissue may be artificially shown as a "layer" (see Figs. 4 and 5). It forms one of the layers of visceral pelvic fascia and is less dense in the middle line where it is only feebly attached to the hollow of the sacrum. Laterally, however, it is very strong and consists of the rectal stalk of Elliot Smith[12], [13], that is, the connective tissue surrounding the middle hemorrhoidal artery and the branches from the sacral nerves to the rectum. In a lateral direction the aponeurosis can, as a rule, be traced to the second, third and fourth anterior sacral foramina. It is the rectal stalk which supports the rectum and it enters the stationary portion of the organ, that is to say the lower portion of the perineal chamber or ampulla. The site is indicated in Fig. 3.

The rectosacral aponeurosis forms a posterior capsule for the rectum and pararectal glands while its most lateral parts, the rectal stalks, are the true rectal support. When it is severed, the whole rectum and a considerable length of the pelvic colon can be withdrawn through a perineal wound.

In the treatise by Quenu and Hartmann the operator is directed to destroy the cellular tissue between rectum and sacrum, " the sacrorectal fibrous tracts and certain insignificant nervous and vascular branches."[14] As these constitute the main support of the organ they cannot in reality be termed insignificant.

It is along the rectal stalk that extension of the growth reaches the sacrum. One further point of interest lies in the fact that severance of the rectal stalks does not interfere with those branches of the nervi erigentes which come from the same roots but pass onward to the neck of the bladder and the genitals. Normal erections occur in individuals after resection of the rectum when the above-mentioned facts receive attention.

It has been the intention of the writer to recapitulate briefly and in relation to an actual case, the anatomical facts of importance in excision of the rectum. As Harrison Cripps remarks,[15] the particular route by which a rectal cancer is removed may be of quite secondary importance. " It is a disease in which it is worth while to err on the side of doing too much rather than too little."

SUMMARY.

The points to which attention is drawn in the foregoing pages are the following:

1. The main support of the rectum consists of the rectal stalks of Elliot Smith and not the levatores ani.

2. The length of the mesosigmoid is usually such as to enable the pelvic colon to be brought down and sutured into a perineal wound without danger of subsequent tension or gangrene.

3. The precarious nature of the blood supply of the pelvirectal junction, the possibility of retrograde lymphatic extension into the mesentery of the distal portion of the pelvic colon, and of cancerous extension along the gut itself, suggest that free removal of rectum and pelvic colon should be undertaken in cases of cancer of the perineal chamber (ampulla).

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STRANGULATION OF THE UNDESCENDED TESTIS.*

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The phrase "strangulation of the testis" is rather loosely used to indicate a severe grade of interference with the blood supply of that organ. It may be brought about by torsion, compression, kinking or stretching of the cord. When one considers the exposed position of the testis, its great mobility, and especially the long stalk or pedicle in which its small and tortuous vessels are conveyed, the wonder is that not more cases of strangulation are reported.

The first recorded case is that of Delasiauve in 1840. Nicoladoni, in 1885, reported two cases of his own and several from the literature. Since then the number has increased rapidly and now amounts to about 150 cases. Of these practically one-third were in frankly undescended testes, while a considerable proportion of the remainder gave some evidence of late or maldescent. Many others showed abnormalities of development. In fact most of the authors have considered abnormal descent or development of the testis a necessary condition of strangulation. On the other hand carefully observed cases have been reported in which no such condition was present.

It is well known that the condition of torsion of the cord cannot be produced in the normal human cadaver, although it has been and is frequently done to stallions to produce atrophy of the testis, and sterility. The probability then is that no one anatomical defect can be called the necessary predisposing cause to strangulation.

True stangulation by constriction at the ring, as in strangulated hernia, is hardly conceivable, although a few cases have been reported of compression of the kinked or looped cord between the body of the testis and the pillars of the ring. A few more are recorded in which the circulation was shut off by excessive stretching of the cord, *e.g.*, when the inguinal testis is forced out of the external ring.

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The great majority of cases, however, are strangulated by torsion, either of the testis on the epididymis, the epididymis on its own axis, or, by far the most often, the testis and epididymis upon the cord. This later condition may occur within the tunica vaginalis, or, very rarely, without it, in which case the tunic and testis are both strangulated.

In this paper no attempt will be made to consider those cases in which a strangulated hernia was present, nor the cases presenting fully descended testes. Cases of inflammation without proof of strangulation, and unoperated mild cases, with doubtful symptoms of torsion, will also be excluded. There are probably many such, which, recurring repeatedly and treated as orchitis and epididymitis, lead to simple atrophy of the gland.

Strangulation may occur at any age, but is most common during the ten years immediately following puberty. It may affect either testicle. Untreated it leads to aseptic gangrene, abscess, or more commonly, simple atrophy. In animals the gland is completely lost after 22 hours of strangulation, while in man 75 per cent. of the cases have had to be castrated, and of the remainder, nearly all sloughed or atrophied. It must be remembered, moreover, that, in the case of the undescended testis, one is dealing with a gland which is frequently abnormal and has already undergone degenerative changes.

In strangulation by torsion, the conditions usually present are (1) a free lying testis, like an ovarian cyst on its pedicle. If the twist is of the testis proper, the true mesorchium, or vascular pedicle of the testis, must be abnormally long. If the testis and epididymis turn upon the cord, the meso-epididymis must be long and covered on each side with reflections from the tunic. More often the testis and epididymis hang free on the cord, like a ball on a string. In this case the mesorchium is said to be absent, but more properly speaking, it is abnormally long.

(2) The relative size and position of the testis and epididymis vary greatly, the latter lying above, below, or even in front of the testis after the twist is reduced. The two may be quite separate, with separate portions of the cord leading to each. The testis may be, and frequently is, flattened and abnormal in shape and position, as is the epididymis also.

(3) The tunica vaginalis is usually well developed and capacious, frequently containing fluid and usually communicating with the general peritoneal cavity.

(4) The cord may be abnormally short or long, is usually well developed but may be flattened out and even divided into two quite distinct bundles, one containing the vas and its arteries, the other the spermatic vessels. In some cases no abnormality was present and there was no apparent anatomical cause for the torsion.

A history of repeated attacks of pain is not uncommon and in some cases undoubted twists have occurred repeatedly, being reduced without operation, or, in a few cases, spontaneously. The testis in these cases has usually atrophied.

The mechanism of torsion is obscure, each author advancing a theory to fit his own case. All lay great stress upon trauma, even though this be of the slightest. Walking, jumping, straining, a slight blow, even the violent contraction of the cremaster, have been advanced as the immediate cause. One author believes that the torsion is of slow development and that symptoms only appear following the last partial turn which completes the obstruction. If this were true, one would surely expect to find occasional twists of the cord in the numerous operative exposures for hernia, etc. Moreover, adhesions would probably form, and the twist would remain after the cord and testis are excised, whereas, as a matter of fact, it nearly always disappears.

In some cases the torsion occurred during sleep, which presumably, but not necessarily, would exclude trauma. One might roll, or kick, even in his sleep.

In a rather noticeably large percentage of cases there is a distinct history of increased intra-abdominal pressure immediately preceding the onset of symptoms. This came from crying, straining at stool, lifting heavy weight, athletic exercises, etc. The condition occurs so frequently to everyone that it cannot be denied as a possible factor in these cases. The force may act upon the different elements of the cord as they approach the internal ring, but more probably is exerted through the open funiculus directly upon the testis, or possibly directly through the weak posterior wall of the canal. A coincident contraction of the cremaster very likely pulls upon one part of the cord more than another, thus starting the twist.

It is easy to see how a quarter turn of the testis may be present at any time, as the flattened testis would naturally lie on its side in the confined space of the canal. A very slight force from behind would then suffice to give another quarter turn, and the torsion is begun. The intra-abdominal force not improbably acts like the force of uterine contractions, forcing the testis onward, causing it to extend and to rotate, especially as it passes either of the rings.

With the onset of torsion great congestion ensues, accompanied usually by a serous transudate, more or less sanguineous in character, into the tunica vaginalis. The increasing congestion dilates the veins, changing their length and thus again increasing the tendency to twist around the unchanged arteries and vas. Why does not the cord untwist spontaneously? Perhaps it does at times and this may explain the recurrent attacks of pain, followed by atrophy, in certain cases. In general, however, the cord does not untwist, perhaps because the irregular shape of the testis and epididymis allows rotation in one direction only. In several cases there has been no apparent reason for the maintenance of the twist, which was easily reduced and showed no tendency to recur. In one case, however, a tendency to immediate recurrence was noted.

The number of twists varies from a half to four or more complete turns, averaging less than two. Curiously enough the left testis usually, though not always, tends to turn clockwise, the right anticlockwise. This may possibly be due to the above mentioned pull on the different elements of the cord, or to the natural tendency of the heavier and larger body of the testis to fall downward and outward toward Poupart's ligament, as it comes through the internal ring. Supravaginal torsion must imply simply a very loose connection between the parietal layer of the tunic and the surrounding connective tissue.

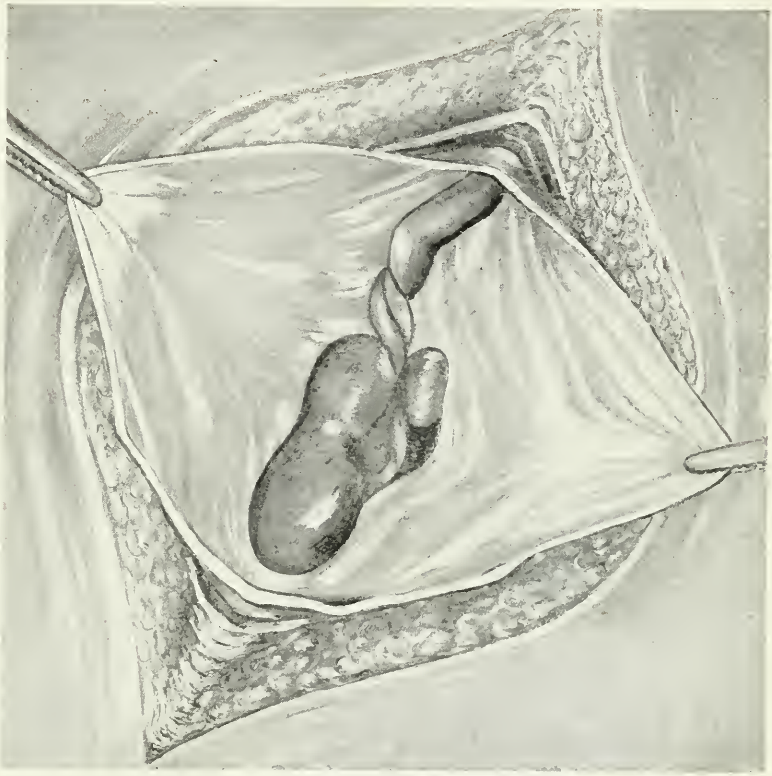
It seems fair then to assume that torsion of the undescended testis is largely due to intra-abdominal pressure, acting directly or indirectly upon the cord and testis: an attempt perhaps, on nature's part, at a forced descent, and comparable to the passage of the fetal head through the pelvic outlet.

The symptoms of torsion closely resemble those of strangulated bubonocele, even in some cases to the extent of complete obstipation. Generally, however, the symptoms are less severe, shock is less in evidence, temperature and pulse are only slightly elevated. Vomiting is apt to occur repeatedly, and the pain is exceedingly severe, much more than in strangulated hernia. This, with the testicle missing from the scrotum, should lead one to suspect the condition, but, remembering the frequent coincidence of a hernia with possible incomplete strangulation, one is never quite sure of the diagnosis. Less than one third of the cases have been correctly diagnosed, a few more have been " guessed at," but the great majority have been treated at first for orchitis, epididymitis or strangulated hernia.

The differential diagnosis from orchitis, epididymitis, and even inguinal adenitis, has to be considered but should not be very difficult if the testis is absent from the scrotum. A coincident Richter's hernia can hardly be excluded, however.

The treatment in the undescended cases is obvious: immediate operation offers the only hope of saving the testis and relieving the patient from intense suffering.

FIG. 1.



Necrosis of testicle from torsion of the cord. (Case I. Peter K.)

The prognosis for the patient is always good: for the testis is nearly always bad, except in very early or very mild cases. The testes removed have all shown tremendous passive congestion, ecchymosis, and subcapsular hemorrhages, with degeneration of the testicular substance, and varying degrees of necrosis, and even gangrene. Infection is rarely present.

Through the courtesy of Dr. William A. Downes the writer was permitted to operate upon and report the following case:

Case I.—Peter K., seven months old, of German parentage and negative family and previous history. Admitted to the Babies' Hospital September 23, 1911. Right testis only in scrotum. Present illness began 5½ days ago, child being cross and fretful, but appetite and bowels were unaffected. Was restless and cried a great deal. Two days ago child appeared to have colic and a purge was given. A few hours later a swelling was noticed in the left groin, which gradually increased in size and soon became red and very tender. Vomiting occurred 3 days ago, again yesterday and two or three times to-day. Seems to be in constant pain and keeps his legs drawn up.

Physical examination was negative except as to slight abdominal tenderness and the presence of a red, tender mass in the left groin, apparently in the inguinal canal and running from the external to the internal rings. No impulse on crying. Dull to percussion. Rectal examination failed to reveal any distended loop of gut leading to the internal ring, which could be readily palpated.

Temperature 102°, pulse 134, respiration 40, leucocytes 19,500, polymorphonuclears 49 per cent., eosinophiles 3, others 49 per cent.

The diagnosis was in doubt until the absence of the left testis was noted, under anæsthesia, when the probability of a strangulated inguinal testis became apparent. Through the usual oblique incision the inguinal canal was exposed, all the tissues being found œdematous. Within the canal a rather thick-walled, bluish sac was found, adherent to the surrounding structures. This, on opening, yielded about half an ounce of blood-tinged serum, and exposed a blue-black irregular mass, the size of a small olive, and attached to a twisted pedicle which ran to and entered the internal ring. The testis was found to be twisted on the cord one and one-half full turns toward the right, that is in a clockwise direction, and, as it appeared gangrenous, it was excised along with the cord. No adhesions were noted. Part of the sac was excised and the aponeurosis and skin closed. No evidence of hernia was seen.

Recovery was uneventful, barring a slight stitch abscess, and the child left the hospital healed on October 10, 1911. When seen six months later, the wound was soundly healed with no evidence of hernia.

The testis and epididymis were enlarged, deeply congested, and showed on section severe interstitial hemorrhages, and only atrophic testicular substance. " Complete necrosis of an atrophic testis" (Prof. Ewing).

Case II.—Operated upon by Dr. Frank Hartley and reported through his courtesy.

Philip C., one year old. New York Hospital. Admitted November 17, 1905. Family and previous history negative. Position of testis not noted by parents. Present trouble began 4 days ago with pain, and repeated vomiting. Child appeared sick, bowels moved to cathartic and improvement took place for 2 days. To-day child seemed in pain and cried on moving its right leg, which was kept flexed. Slight fever. Doctor noted swelling in right groin and diagnosed strangulated hernia.

Physical examination negative except as to a swelling in the right groin size of a small egg, hard, tender, irreducible. No impulse. Right testis not felt in scrotum.

Temperature 101°, pulse 128, respiration 26, leucocytes 25,600, polymorphonuclears 72 per cent. Diagnosis, strangulated right inguinal hernia.

Operation (by Dr. Hartley).—Inguinal canal opened, swollen tunica vaginalis incised and a considerably enlarged testis and epididymis, dark bluish-red in color, exposed. Strangulation due to a twist of testis and epididymis on cord, direction not noted. Mass excised along with the adherent tunica vaginalis. No hernia noted. Sutured and healed per primam. Slight fever, but ultimate complete recovery.

Examination of Specimen.—An irregular mass 2.5 x 1.5 x 1 cm. with indistinct epididymis, and a membranous pouch. Very hemorrhagic testis and epididymis. Sections showed diffuse hemorrhagic infiltration of loose cellular tissue and the tubules of a rudimentary testis.

Case III.—Operated by Dr. Frank Mathews, and reported through his courtesy.

Philip K., five years old. St. Mary's Hospital for Children. October 2, 1911. Family and previous history negative except that mother and boy have pronounced Madelung's deformity of the forearms, *i.e.,* great relative shortening of the radius and of the whole forearm as compared to the upper arm.

Present illness began yesterday, pain in right groin, vomiting. Pain became severe and child refused to walk.

Physical Examination.—Negative except for the right groin where a mass the size of a pigeon's egg could be seen and felt just above the pubic spine. Very tender. Right testis not down. Left in scrotum.

Operation (by Dr. Mathews).—Twenty-four hours from onset. Inguinal canal exposed and dark blue mass found protruding from external ring. Proved to be testis; cord very taut but no torsion. Small empty hernial sac dissected from cord and ligated and removed. Cord loosened up and testis, which had regained its color, pushed into scrotum. Conjoined tendon united to Poupart's, and external oblique and skin sutured without transplanting cord.

Wound healed promptly except for a stitch abscess, and the child left the hospital on October 25, the wound solid and the testis in fair position at the upper scrotal margin. This appeared to be a case of strangulation by forcible stretching of the cord in a sudden effort to cause descent of the testis.

Table I contains all the cases of strangulated undescended testes in the available literature. Table II gives those of late descent. References are added to all the reported cases of strangulated testes, many of which probably belong in classes I or II, but the data given are inadequate for classification. Table III is compiled from Table I.

TABLE I.—UNDESCENDED CASES.

Number	Author	Age	Side	Clockwise	Anticlock wise	Degrees	Previous attacks	Diagnosed	Excised	Cause	Vomiting	Constipa-tion	Contents of tunica vaginalis	Remarks	Reference
1	Scarenzio	41	L.	+	..	720	..	O	+	Severe labor	+	+	Yellow fluid	"Free" testis	Annali Universali di méd. vol. clxx, 1859. P. 595 (Milan).
2	Nicoladoni	16	R.	..	+	180	+	O	+	....	+	O	Bloody fluid	"Free" testis	Archiv. f. klin. Chir. Bd. xxxi, 1885. P. 182.
3	Cohen, Schmidt	28	R.	..	+	360	+	O	+	Jumping	O	O	Bloody fluid	....	Deutsche Zeitschr. f. Chir. Bd. xxx, 1890. P. 101.
	(Helferich)														Centralblatt f. Chir. 1890. P. 215.
4	T. Bryant	15	L.	+	..	540	O	O	O	Bicycle ride	..	+	Dark blood	Atrophied later	Trans. of the Royal Med. Chir. Soc. 1892. P. 247 British Med. Journal. Feb. 27, 1892.
5	Anders	13	L.	..	..	540	..	+	+	....	..	..	Clear fluid	Epididymis only	St. Petersburg med. Wochenschr. 1892. P. 437.
6	Davies Colley	14	R.	..	+	1080	..	O	O	None	+	+	Bloody fluid	Testis sloughed	Brit. Med. Journ. 1892 (i). P. 811.
7	Barker	15	R.	..	+	540	..	O	+	Defecation	+	+	Bloody fluid and clots	....	Lancet. 1893 (i). P. 792.
8	E. Owen	13	L.	+	..	180	..	+	+	Playing	+	..	Bloody fluid	Two pockets in tunic	Lancet, 1893 (ii). P. 1247.
9	Lauenstein	25	R.	..	+	180	O	+	+	Lifting	+	O	Bloody fluid	....	Volkmann's Sammlung klin. Vortraeger, 1894. P. 1.
10	Legueu	13	R.	..	+	360	..	+	O	Playing	+	..	Bloody fluid	Extra vaginal; epididymis dark. Saved	Bull. et. mém. d. l. Soc. d. Chir. July 15, 1896.
11	Macaigne & Vanwerts	15	L.	+	..	540	+	+	+	....	+	O	Bloody fluid	....	Bull. d. l. Soc. Anatomy, 1898. P. 267.
12	Gerster	21	R.	..	..	.....	..	?	+	None	+	..	....	Sarcoma abdom'l	ANNALS OF SURGERY, v. 27, 1898. P. 649.
13	Wirsinger	1½	R.	..	..	360	..	?	+	....	..	..	Bloody fluid	....	Aertz. Verein in Hamburg. Feb. 7, 1899.
14	Dowden	14 mos.	L.	+	..	540	..	?	+	....	+	+	Dark blood	....	Scottish Med. and Surg. Journ. 1901. P. 221.
15	Dowden	5 mos.	L.	+	..	1260	..	+	+	....	..	..	Bloody fluid	....	Scottish Med. and Surg. Journ. 1901. P. 221.
16	Tuffier	18	L.	..	+	720	..	+	+	Defecation	O	O	Bloody fluid	....	Bull. dele Soc. de Chir. de Paris v. xx, 1903, P. 551.
17	Turner	13 mos.	L.	..	+	360	..	O	+	....	O	O	Little fluid	Broad mesorchium	Brit. Med. Jr. v. 2, 1903, P. 1403.
18	Sauerbrey	11	L.	+	..	270	+	O	+	....	..	O	Bloody fluid	....	Sin Kasuist. beitrag zur Torsion des Leisten Hodens, Jena, 1904.

19	Grunert	5	L.	+	..	360	..	O	+	....	+	+	Bloody fluid	....	Münch. Med. Wochn, Bd. xliii 1904. P. 1912.
20	Bogdanik	....	..	..	..	.....	..	+	..	....	..	..	....	....	Wien. Med. Presse, 1905, P. 2274.
21	Hugier	19	L.	+	..	180	..	?	+	Walking	+	O	No serum	A few adhesions	La Tribune Med. Oct. 6, 1906, P. 597. Bull. Anat. Paris, v. lxxxi, 1906, P. 567.
22	Corner	19	L.	..	..	360	+	..	+	....	O	..	....	Hernial sac	Diseases of the Male Generative Organs, 1907.
23	Corner	2½	R.	..	+	360	..	+	+	....	..	..	Bloody serum	....	Diseases of the Male Generative Organs, 1907.
24	Heaton	24	..	..	..	.....	..	O	+	Cough	+	+	Blood	No torsion noted. Strangled by the external ring	Brit. Med. Journ. v. 2, 1905. P. 1342.
25	Schwartz	....	R.	+	..	720	..	?	+	Labor	+	+	O	....	Jahres b. d. ii chir. klin zu Wien (1906) 1907, P. 45.
26	Boese	38	L.	..	+	180	+	O	+	....	O	O	....	Sarcomatous. Abdominal testis	Wien. Klin. Wochn. Bd. xx, 1907, P. 316.
27	Rigby & Howard	7	R.	..	..	.....	..	..	+	....	+	O	....	....	Lancet, v.i, 1907, P. 1415.
28	Rigby & Howard	2	L.	..	..	.....	..	..	+	....	+	..	....	....	Lancet, v.i, 1907. P. 1415.
29	Rigby & Howard	34	R.	..	..	.....	..	..	+	....	+	O	....	Bloody fluid	Lancet, v.i, 1907, P. 1415.
30	Rigby & Howard	16	L.	..	..	180	..	?	..	....	O	..	....	....	Lancet, v.i, 1907, P. 1415.
31	Bruch (Routier)	18	L.	..	..	.....	..	O	+	....	+	+	....	Torsion and kink. Testis burst	Bull. et. mem. d. l. Soc. d. Chir. de Paris, v. xxxiv, 1908, P. 721.
32	Tytgat	20	R.	..	..	720	..	O	O	....	+	O	Serum and blood	....	Bull. d. l. Soc. d. méd de Gand. v. lxxvi, 1909. P. 93.
33	Duchanet et Vial	23	L.	..	..	720	+	O	O	....	..	..	....	Adhesions	La Loire Médicale, v. xxviii, 1909, P. 87.
34	Batchelos	12	R.	+	..	720	..	O	+	None	+	+	....	In congenital sac. No mesorchium	N. Zealand M. J. v. iv, 1905, P. 277.
35	Nassano	27	R.	..	..	.....	..	+	+	Work	O	O	Bloody fluid	....	Gaz. med. ital. Torino, lvii, 1906, P. 261.
36	Le Conte	28	R.	..	..	360	..	..	+	....	O	..	....	Sarcoma. Intra-abdominal	Trans. Coll. Phys. Phila., xxix, 1907, P. 109.
37	Lang, H.	2¾	R.	+	..	360	..	+	+	....	O	O	....	Epididymis infarcted	Mitt. aus d. Hamburg. Staatsk, vii, 1907. P. 265.
38	Cuneo, Mauclaire, etc.	16	R.	..	..	.....	..	+	+	....	O	+	....	No torsion found	Bull. et. mem. Soc. Anat. Par. lxxix, 1904, P. 718.
39	Pillet	32	..	..	..	Several turns	..	O	+	Severe labor	..	+	Yellow serum	Interstitial sac	Rev. Gen. d. Chir. et. d. Therap. Paris, xxv, 1911, P. 806.
40	Lofberg	9 mos.	L.	..	+	720	..	O	+	....	+	O	Bloody serum	....	Hygiea, lxxiii, 1911, P. 1081.
41	Lofberg	3½ mos	L.	..	+	360	..	+	+	....	+	O	Bloody serum	....	Hygiea, lxxiii, 1911, P. 1081.
42	Delbet	35	R.	+	..	180	..	O	+	Muscle strain	..	..	....	Extravaginal	Paris Chirurg., iv, 1912, P. 65.
43	Farr	7 mos.	L.	+	..	540	O	+	+	....	+	O	Bloody serum	....	Writer's case.
44	Farr	1 yr.	R.	..	..	.....	O	O	+	....	+	O	....	....	Hartley's case.
45	Farr	5 yrs.	R.	..	..	.....	O	?	O	....	+	..	....	Strangled by forced extension	Mathew's case.

TABLE II.—CASES OF LATE AND IMPERFECT DESCENT.

Number	Author	Age	Side	Clockwise	Anticlock wise	Degrees	Previous attacks	Diagnosed	Excised	Cause	Vomiting	Constipation	Contents of tunica vaginalis	Remarks	Reference
1	Delasiauve	15	L.	..	..	Several turns	+	..	+	None	N	O	....	Extravaginal	Revue méd francaise et étrangère, 1840, P.363.
2	Lexer	60	L.	..	+	270	+	O	+	Labor	..	..	Bloody serum	....	Archiv. f. klin. Chir. Bd. xlviii, 1894, P. 201.
3	Vander Poel	25	R.	+	..	720	+	+	O	None	..	..	....	Hernia operated later. Testis O.K. 1912.	Medical Record. v. xlvii 1895, P. 737.
4	De Quervain	50	L.	..	..	.....	..	+	+	Lifting	O	O	....	Kinking of cord	Deut. Zeitscrift f. Chir. Bd. lxi, 1901, P. 271.
5	Ware, M. W.	19	R.	+	..	520	O	?	+	None	+	O	Blood	Blind pouch below	Personal communication.
6	Dupuy and Brant-homme	16	L.	..	..	180	+	?	+	Slight fall	O	O	Bloody serum	At external ring	Tribune Médicale, Paris, xxxvii, 1905, P. 22.
7	Perry	16	R.	+	..	.....	..	..	..	....	..	..	....	....	Birmingham Med. Rev. 1898, P. 279.

TABLE III.

Age.[1]

Under 1 year, 4
1– 5 years (inclusive), 13
1–10 years (inclusive), 14
1–12 years (inclusive), 16, 36 per cent.
13–16 years (inclusive), 10, 22 per cent.
17–30 years (inclusive), 12, 27 per cent.
Over 30 years, 5
Not mentioned, 2

Right 21.		Left 21.		Not mentioned 3.
Clockwise	Anticlockwise	Clockwise	Anticlockwise	Not mentioned
4	7	10	5	19

[1] Total number of cases, 45; youngest, 3½ months; oldest, 41 years.

Greatest degree of twist, 1260
Least degree of twist, 180
Average degree of twist, 480, in 33 cases
Not mentioned, in 10 cases
None found, in 2 cases

Previous attacks, 7 cases

Diagnosed before operation, 14 times
Not diagnosed before operation, 19 times
Proper diagnosis considered, 7 times
Not mentioned, 5 times

Cause—straining, jumping, etc., 14 cases
No cause present, 3 cases
Unknown, 28 cases
Vomiting, 25 cases
No vomiting, 10 cases
Not mentioned, 10 cases
Constipation, 12 cases
No constipation, 18 cases
Not mentioned, 15 cases
Excised, 37 cases
Saved, 4 cases
Saved and sloughed or atrophied, 2 cases
Not noted, 2 cases

The following case, seen after the preceding observations were written, is of considerable interest from the diagnostic standpoint. C., aged seven years, of negative family and personal history until a year ago, when the parents first noticed that the right testis was not in the scrotum. The boy had been playing "see-saw" and complained of great pain in the right groin, where a small lump was noticed. The pain soon passed away but recurred at intervals during the year past. On the night of admission to St. Mary's Hospital, June 11, 1913, the boy was taken with excruciating pain in the right groin, following excessive climbing. His bowels had not moved during the day but were regular previously. There was no vomiting. A tender lump was felt in the right groin. The boy was brought 30 miles in an automobile and vomited 3 times during the trip. On admission, a very healthy looking boy, no evidence of shock. No distention, temperature 99°, pulse 90. Left testis normal, right scrotal sac empty. In the right groin, at the external ring, an exceedingly tender lump, size of pigeon's egg, slightly movable, giving no impulse. At the level of the internal ring a slight elevation was noted extending along the canal. Diagnosis, strangulated inguinal testis with possibly a Richter's hernia.

Immediate operation, 7 hours after onset of symptoms. Usual Bassini exposure. The tumor at the external ring was found to be a tightly strangulated loop of ileum, containing hard fæces, and caught by the external ring. This was freed, examined and reduced. The testis was found at the internal ring, atrophic, misshapen, and showing no evidence of torsion or other injury. The Bevan operation was performed and the child made a perfect recovery. This teaches the difficulty of excluding a strangulated hernia in these cases, and the folly of expectant treatment as advised by some writers.

The author wishes to express his appreciation of the courtesy of Doctors Hartley, Downes, Mathews and Ware in allowing the publication of their cases. Doctor Ware also reported several cases of strangulation of descended testis, as did Doctor Moschcowitz, at the meeting of the Surgical Society, at which this paper was read.

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SARCOMA OF THE CHEST WALL.

BY J. F. BALDWIN, M.D.,

OF COLUMBUS, OHIO,
Surgeon to Grant Hospital.

The comparative rarity of operations for tumors involving the chest wall is well indicated by the statistical article by Lund, in the ANNALS OF SURGERY, August, 1913, in which he refers to Parham's paper, published in 1898, in which the writer had been able to collect only fifty-two cases of surgical operations in which the pleural cavity had been opened. To these cases Lund is able to add twenty-eight, and he reports one case of his own.

The probability is that there are a good many surgeons who have operated in cases of this kind, but who have never reported their results. I can add to the number three cases of my own, two being cases of primary sarcoma, and one of secondary carcinoma.

CASE I.—R. A., aged eight. Physician, Dr. C. U. Hanna, Zanesville, Ohio. Operation, October 20, 1906. Patient had complained of a little soreness in his right side for a number of months, but his complaints were slight, and nothing had been noticed to account for them until a very few days before he had been brought to me. At that time a swelling was noticed by his mother in the right side, and a physician at once consulted. His general health had apparently not been particularly affected by the growth. The growth was found to be low down on the right side, and to apparently involve more than one rib. Everything was quite tender in that region. The outlines of the tumor were not distinct. X-ray examination showed the eleventh rib was the only one involved. At the operation this rib was completely removed, with opening of the pleural cavity. In anticipation of its being opened, a gauze sponge had been promptly applied so that there was only partial collapse of the lung. Hemorrhage was rapidly controlled, and the incision closed without drainage.

No shock. He made a prompt recovery. A letter received from his physician under date of August 16, 1913, states that patient is in perfect health. The diagnosis of osteosarcoma was confirmed by microscopical examination.

Case II.—Mr. A. P., aged thirty-two. Physician, Dr. L. P. Brumm, Celina, Ohio. Operation October 23, 1912. I had operated upon this patient something more than a year before for chronic appendicitis. Sometime after this he commenced complaining of pain in the back, but nothing could be found by his physicians to account for the trouble. He finally consulted Dr. Brumm, who found a tumor on the right side between the scapula and the spine, and referred the case to me. Examination showed a bony tumor at the point indicated. This was about three inches in diameter, and involved several ribs. A radiograph confirmed the diagnosis, and showed that three ribs were in the growth, but the vertebræ seemed to be free. I advised operation, but giving a very doubtful prognosis as to the ultimate result. In operating it was necessary to remove parts of four ribs. The ribs were cut well forward of the growth, the scapula being pulled to the outside. After removal of the mass it was found that the transverse processes of the vertebræ were involved, and these were accordingly cut away. There was free hemorrhage, which, however, was controlled. The lung had completely collapsed. The pleural cavity was cleaned of blood, and the flap closed without drainage. Very little shock. I had expected to aspirate the air within a few days, but it was rapidly absorbed and the patient left the hospital a little later in excellent condition, healing having taken place by primary intention. Microscopic examination showed osteosarcoma.

Under date of November 27, his physician wrote me that he feared there was beginning trouble, and I advised him to use Coley's serum. Under date of August 18, Dr. Brumm writes that patient did not take the Coley serum, but fell into the hands of quacks, and while still alive is nearly at the end.

Case III.—Mrs. E. A. A., aged fifty-four. Physician, Dr. T. W. Rankin, Columbus, Ohio. Operation May 18, 1913. I had removed the left breast of this patient for cancer in November, 1909. She had made an excellent operative recovery, but some months before she returned a tumor had developed just to the left of the sternum, and involving some of the cartilages of the ribs. There were no signs of recurrence anywhere else, and her general health was good. I advised removal of the growth. This was done by an elliptical incision, going well away from the tumor. The cartilages were cut through with strong scissors, opening the pleural cavity quite widely. The opening was kept closed as best my assistants could with gauze sponges, but there was extensive collapse of the lung. Hemorrhage was controlled, and the tissues around undermined so that the opening was entirely covered by skin. Practically no shock. Patient made an excellent operative recovery.

BOOK REVIEWS.

A MANUAL OF SURGICAL TREATMENT, by SIR W. WATSON CHEYNE, Bart., C.B., D.Sc., LL.D., F.R.C.S., F.R.S., Hon. Surgeon in Ordinary to H. M. the King; Senior Surgeon to King's College Hospital, and F. F. BURGHARD, M.S. (Lond.), F.R.C.S., Surgeon to King's College Hospital, and Senior Surgeon to The Children's Hospital. New (2d) edition. Thoroughly revised and largely rewritten. In five octavo volumes. Lea & Febiger, Publishers, Philadelphia and New York, 1913.

Volumes I and II of this manual were reviewed in the ANNALS OF SURGERY for September, 1912. Volume III describes the surgical affections of the joints, head, face and spine (pp. 515). This is a very well-balanced volume and full of practical interest. The better of the newer methods are given due consideration. One notices, however, that the treatment of Pott's disease by the insertion of a bony transplant is not considered—perhaps wisely while the procedure is *sub judice.* Intracranial surgery is treated very briefly, for instance, no mention is made of the surgery of the pituitary body. Volume IV describes the affections of the jaws, tongue, and floor of the mouth, the pharynx and the œsophagus. The surgical affections of the stomach and intestine, including the rectum, comprise the rest of the book.

This portion of the work equals the high standard reached by the previous volumes and is full of sound doctrine and valuable practical instruction. The section on the large intestine might have been elaborated to advantage in view of the increasing possibilities of treatment, diverticulitis for example. So far as this manual is concerned the resources of the X-ray might be said not to exist, so meagre is the hint of their usefulness. Both volumes are generously illustrated, the diagrams, many of them new, are remarkable for their efficiency in demonstrating essential features.

CHARLES L. GIBSON.

A SYSTEM OF SURGERY. Edited by C. C. CHOYCE, B.Sc., M.D., F.R.C.S., and J. MARTIN BEATTIE, M.A., M.D., C.M. Three vols., each 1000 pp. Funk, Wagnalls Co., New York.

The first two volumes of this work are presented for review. Various commendable features immediately attract attention, among them the general compilation of the work, the noticeable excellent selection of the illustrations and the absence of space consuming, useless and threadbare ones. The detailed descriptions of various technic for the same operation which so soon become obsolete and only of historic value, is not given the valuable space needed and here utilized for the more practical surgical pathology and diagnosis.

Where operative procedure is considered the authors have stated the surgical object to be attained and specified the technic believed by them to be the best. Where radical difference of opinion exists as to the choice of two procedures they have given both with the reasons for their preference.

One hundred and eight pages of modern bacteriology, excellently compiled and presented, occupy the first volume, likewise forty pages are devoted to the pathology of pus producing infections.

The subject of surgical shock receives less attention than it deserves, and no recognition is given the fine work of Crile and Henderson on this subject nor on that of general and local anæsthesia.

Particularly valuable are the thirty pages on radiography with their special attention to the errors of interpretation and technic.

Gastro-intestinal surgery is dealt with in the light of the most modern diagnostic and operative progress and occupies four hundred and thirty-one pages of the second volume. The importance of the relation between various colonic bands and membranes, and chronic intestinal stasis are not given the attention that American experience would dictate.

The chapters on urology at the end of the second volume are surgically very practical and contain much that is of value relative to the prostate and methods of differential diagnosis.

In contrast to other surgical works an extensive bibliography is found at the end of each chapter; this with a particularly complete and well arranged index and many explanatory footnotes recommend the work as worthy of high commendation.

W. C. WOOLSEY.

FIBROIDS OF THE UTERUS: THEIR PATHOLOGY AND TREATMENT. By SIR JOHN BLAND-SUTTON, F.R.C.S., Surgeon to the Middlesex Hospital. Pp. 240, xxvi, with 39 illustrations. London, Science Reviews, Ltd., 36–38 Whitefriars St., E. C.

This little volume presents in a clear and readable manner the main facts regarding the pathology, symptoms, differential diagnosis, and treatment of fibroids of the uterus. The author has a preference for hysterectomy, partial or complete, to more conservative treatment, and gives numerous reasons, such as the difficulty in differential diagnosis in some cases between a fibroid and a sarcoma, even when aided by the microscope; the danger of overlooking a second fibroid when performing enucleation; and the satisfactory results obtained by hysterectomy.

Exception may be taken by some to the general application of certain of the author's dicta, for example, that "Fertility protects against fibroids but predisposes to cancer of the neck of the uterus," that "Dry gauze and dabs are harsh and irritating to the peritoneum and a cause of adhesions," and to his exclusion from the list of necessary instruments and description of the operations of any reference to retractors. Among the more interesting chapters of an instructive book are those on the clinical features of uterine fibroids; the differential diagnosis of fibroids and pregnancy; the relative value of subtotal and total hysterectomy, and the fate and value of belated ovaries.

The work is well got up, of convenient size for the hand, and its value is much enhanced by numerous illustrations.

JOHN A. C. MACEWEN.

THE MODERN HOSPITAL. By JOHN ALLAN HORNSBY, M.D., and RICHARD E. SCHMIDT, Architect. Philadelphia: W. B. Saunders Co., 1913.

This book deals with the problems incident to the creation and operation of institutions for the care of the sick, whether public, private, mixed, or special hospitals. An introductory chapter describes the three main classes of hospitals. The authors look upon the hospital as in a state of evolution, out of which are now developing certain fixed principles. One important and hopeful thing, which they recognize is, that the time is shortly coming when the acceptance of a patient will carry with it an obligation to furnish every known and approved scientific aid for the diagnosis and treatment of disease, irrespective of whether the patient is a pay patient or a charity patient.

It is evident that the sociology of the hospital problem is getting into line with the modern social trend. It is getting itself set right with reference to human values and obligations. The distinctions between taxpayer and poor man are melting away in the light of the knowledge that every workman is a taxpayer.

This book deals not only with the economics of the hospital, but with its construction also. The architecture and general plan, in all their finer details, are so well described, that it will serve as an authoritative guide in hospital development. The modern innovations are not wanting. The methods of construction and maintenance of the operating suite, signalling systems, refrigeration, vacuum cleaning, sun rooms, stool and urine sterilizers, anæsthetizing apparatus, food cars, and other appurtenances which have undergone recent changes, are found well described. The minutiæ of such parts as window frames, plastering, and furring, screens, blanket warmers, and the lighting system are not neglected.

The chapter on equipment embraces practically everything from boiler room to kitchen and from wards to operating room.

The operation of the hospital is discussed in its practical details. The board of directors, the superintendent, the medical staff, the nursing staff, operating room supplies, the department of pathology, the department of hydrotherapy, dietetics, isolation, the X-ray department, records, social service and out-patient work, business management, laundry, bakery, and the destruction of waste, are some of the subjects elaborated.

The rules for the administration of technical departments testify to the authors' experience in hospital work. Concerning the board of directors, it is stated that, " the crying need in directorates of institutions in this country, operated without profit, is for men and women who will take a personal interest,"—and, we might add, who possess common sense, tinctured with zeal for the truth, who are capable of growth, and who make the cure of the patients the supreme object of their hospital interest. It is to the everlasting disadvantage of our hospitals that boards of directors are loaded up with men whose chief merit is that they are eminently respectable, that they are the friend of some body of alleged importance, that at some time they performed a service which merits eternal reward, that they may bequeath a bit of their property to the hospital, or that they may bestow upon an eleemosynary institution in their old age the same sagacity which they employed in accumulating a fortune in their youth, and whose function as directors consists in utter indifference to the needs of the institution, or expresses itself in meddlesome activities in some department of its affairs in which they have little aptitude, and to which they give freely of their time, because it is the chief thing they have to expend. It is to be regretted that the author has not specifically advised the appointment of progressive, independent, medical men on the directorate of hospitals.

The chapter on the superintendent is practical and full of suggestions. It might wisely be adopted as a code by the Association of Hospital Superintendents. The first sentence in the chapter on the medical staff is: "The medical staff is the most important factor in any hospital." This should be accepted as a watchword and guide by every board of managers, for too many accord the supreme place to "our board of managers"; or to "our splendid superintendent"; or to "our beautiful building"; or to "our ministering angels, the nurses"; or to "the popularity of our medical staff." In reality, these estimations are often correct; but woe betide the patients when anything is more supreme than the competence of the medical staff.

The ethics of interneship embraces a discussion of the relation of the house staff to the nurses, in which the author displays rare judgment in dealing with a difficult problem, and shows that he is human as well as astute. The trained nurse and the training school are illuminated by a judicious discussion. The author believes that there is a place for two classes of nurses—the highly trained and the more menial nurse. The problem of the male nurse he regards as discouraging.

The whole spirit of this book is admirable. The authors frankly state that it is based upon their own experience with little reference to the work or opinions of others. The shortcomings, of which they warn the reader, have eluded the vigilance of the reviewer.

James P. Warbasse.

The Catarrhal and Suppurative Diseases of the Accessory Sinuses of the Nose, by Ross Hall Skillern, M.D. J. B. Lippincott Company, Philadelphia and London, 1 vol., Roy 8, pp. 1–xx, 1–389.

This book embodies in a formal treatise for the first time in the English language the results of recent endeavors in the investigation and treatment of disorders of the nasal sinuses. It, therefore, takes a place, hitherto unoccupied, of importance and interest; and the author must be accorded the thanks of that considerable number of English speaking rhinologists who do not read other languages with facility, for the collection of a large mass of foreign literature, apart from the actual merits of the book itself.

In the first part of the work—General Considerations—is embodied the anatomical study of the regions treated, which the author for convenience has divided dogmatically into three portions which he calls 1. inferior turbinal portion, 2. middle turbinal portion, and 3. ethmoidal portion. These include the entire outer wall of the interior of the nose and are examined, seriatim, superficially (from within the nose) and the successive structures beneath them (from within outwardly). Thus the turbinates are removed in order to examine the ostiums of the sinuses and contiguous structures, then the sinuses themselves. To facilitate this anatomical study besides numerous text cuts, a frontispiece is arranged with three overlapping sheets of translucent paper each of the latter having printed on it a separate portion of the structures overlying the sinuses, with explanatory marginal text. The structures entering into the formation of the sinuses are then examined piecemeal and collectively. The development of the sinuses from birth is traced. This first part further contains, under separate headings, the physiology of the sinuses, their uses, including the various present and former theories regarding them, the mechanism of their normal drainage, their bacteriology, causes of their diseases, the reasons for chronicity, their pathology, general symptomatology, diagnosis, treatment and complications.

The four subsequent parts of the book treat, respectively, the maxillary, the frontal, the ethmoidal and sphenoidal sinuses. In each of these divisions the author expounds the anatomical relationship of each, normal and abnormal, their acute and chronic inflammations, the methods of the surgical examination of each, their respective complications, etiology, pathology, prognosis and surgical treatment, detailing the steps of the various operations of well-known authorities.

This work is much more than a mere compilation covering the recent advances in the entire field of the surgery of the nasal accessory sinuses. It is a well planned book in which all pertinent details have been conscientiously presented.

The reviewers feel personally grateful to the author, who has placed in convenient form, and more fully than has heretofore been attempted in English, the diagnosis and treatment of the nasal accessory sinuses. The 247 illustrations, the 5 colored plates and the novel frontispiece, spoken of, are newly made for the book.

William C. Braislin.

Manual of Surgery. By Francis T. Stewart, Professor of Clinical Surgery, Jefferson Medical College. Third Edition, 742 pages, and 571 illustrations. Philadelphia: P. Blakiston's Son & Co., 1913.

This book contains a vast fund of information so arranged and presented that it holds the attention of the reader from the first to the last page. The entire field of surgery, including much of the operative work of the orthopædic surgeon, gynæcologist, otologist and laryngologist, is covered. Ophthalmology alone is omitted. There is no unnecessary discussion of unsettled points. The facts of surgery are clearly and concisely stated in the way best calculated to impress them upon the reader, and every page bears the personal imprint of the practical surgeon and teacher. Nearly all the latest advances in surgery have been incorporated in this edition, but the statement on page 468, " All attempts thus far to resect a portion of the thoracic gullet have been fatal," is no longer true, for Torek has reported a successful case since the book went to press.

The section on Surgical Technic is especially good. It is evident that the author has drawn chiefly upon his own experience, and for this reason it has additional value. The older method of preparation is favored rather than the present more popular iodine one.

Most surgeons will take exception to the statement that "Always at the close of an operation it is desirable to flush the wound with hot sterile water or salt solution," especially when this procedure is advised later on for chronic brain abscess, wounds of the spine, chronic empyema, peritonitis, appendiceal abscess, etc.

The chapter upon the abdomen is the best in the entire book. Gastric and duodenal ulcers are considered in a simple, plain and thoroughly up-to-date way. The present views of most surgeons are embodied in this section, which is neither too conservative nor too radical in its advice. The necessary operations are well described and illustrated by excellent colored cuts. Compression of the duodenum by the mesentery of the small intestines, membranous pericolitis, diverticulitis, and Lane's kink all receive appropriate attention. No surgical condition of importance seems to be omitted.

The index is extensive and complete. This book can be highly recommended to those for whom it is intended—the student and general practitioner—and many a mature surgeon could profitably spend a few hours in its perusal.

It would be very difficult to find another single volume of this size that so thoroughly covers the field of surgery and in which so little could be found to criticise, and so much to praise.

Henry Flack Graham.

CORRESPONDENCE.

CONTRACTURE OF PSOAS MUSCLE SIMULATING APPENDICITIS.

Editor of The Annals of Surgery:

After reading the paper by Dr. George E. White on "Contracture of the Psoas Parvus Muscle Simulating Appendicitis," in the Annals of Surgery for October, 1913, I wish to place on record a similar case, which was operated upon by me in 1904.

Mrs. B. H., age twenty-five, complained of constant pain over McBurney's point, also some pain and tenderness in the lumbar region of the right side. The diagnosis was finally made of chronic appendicitis and patient was operated upon in 1904. The appendix appeared to be practically normal, but underlying the appendix was a rather tense, whitish, contracted band, which was observed at the time and commented upon. Nothing was done with this, however, at the time.

The patient received practically no benefit from the operation, the pain continuing for several years. No secondary operation was done, but the cause of the continued pain was attributed to the contracted psoas muscle, the cause of which was unknown. No evidences of general or local tubercular trouble.

James L. Stewart,
Boise, Idaho.

ANÆSTHESIA SUPPLEMENT

ANNALS OF SURGERY
DECEMBER, 1913

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THE AMERICAN ASSOCIATION OF ANÆSTHETISTS.

BY JAMES T. GWATHMEY, M.D.,

OF NEW YORK.

PRESIDENT'S ADDRESS.*

IMMEDIATELY following a symposium on anæsthesia, held under the auspices of the Sections on Physiology and Pathology of the American Medical Association, at the meeting at Atlantic City, June 12, 1912, the American Association of Anæsthetists was organized.

The prime object of the organization, as expressed in its constitution and by-laws, is to advance, in every way possible, the science and art of anæsthesia.

In order to accomplish this it is the purpose of the Association to stimulate experimental and clinical investigations by endeavoring to bring together, at its annual meetings, representatives of the allied branches of science—surgeons, physiologists, chemists and pharmacists, as well as anæsthetists—for conference and comparison of data with reference to special phases of the subject which they are actively engaged in developing.

Such annual inventories of achievement serve the double purpose of stimulating effort in predetermined lines, and of clearly revealing lines toward which investigation should be directed. The truth of this may be realized and the possibilities of correlated effort may be understood when it is brought to mind that more real progress has been made in the study of anæsthetics and anæsthesia during the last ten years than during the rest of the sixty-five years which have elapsed since the first public demonstration of anæsthesia was made.

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* Read at the first annual meeting of the American Association of Anæsthetists, Minneapolis, Minn., June 18, 1913.

For many years little attention was paid to the administration of anæsthetic agents in combinations and sequences, chloroform, ether, nitrous oxide, the three anæsthetics employed, being used alone each in its respective field. The earlier administrators, therefore, failed to utilize underlying principles which are conducive to increased efficiency and to a modification of unpleasant effects in the induction period, during the course of the anæsthesia, and during the time of recovery.

This state of affairs is probably accounted for by the fact that anæsthesia has always been considered as a part of surgery and consequently has been under the direct supervision of the surgeon, generally administered by nurse or other untrained assistant. There has consequently developed a tendency to employ some one method, notably the drop method of ether, in practically all cases, thus suiting the patient to the anæsthetic rather than the anæsthetic to the patient. This error is not uncommonly committed, we might say, on a wholesale scale, in certain localities and in certain institutions to-day. This is abundantly proved by the American statistics, recently compiled by the Committee on Anæsthesia of the American Medical Association. These figures show that more than half of nearly half a million administrations, from 1905 to 1912 inclusive, were given by the drop method of ether. The mortality record of this method, as compared with sequences and combinations selected to suit the individual case, is relatively high. In 294,653 administrations of ether by the drop method there were 65 deaths, giving a ratio of 1 death in 4,533 cases. This does not compare favorably with the chloroform-ether sequence of 1 death in 10,007, or the nitrous oxide-ether sequence of 1 in 6,424.

The fallacy of the position assumed by many surgeons, of having nurses instead of physicians administer anæsthetics, is two-fold: In the first place, skilled anæsthetists, know from laboratory experimentation and clinical experience, that ether alone, by the drop method, is less safe than when it is used in sequence or combination with other agents, and administered by other methods. This applies to safety to life, to muscular relaxation for surgical purposes, and to after-effects. In the second place, it is now generally conceded that the anæsthetic should be selected with respect to the individual case. In order to accomplish this, combinations and sequences must be employed. It goes without saying that this is impossible for the administrator who is untrained in the giving of anæsthetics in general, and who is ignorant of the physiological action of the agent or agents employed.

The position assumed by many with reference to anæsthesia is, therefore, wrong in principle. It is out of harmony with the trend of development of modern medical science. It is certainly not in keeping with the spirit and purposes of the Association of American Medical Colleges, of the American Medical Association, and of the Carnegie Foundation, all of which organizations have aimed at the elevation of the standard of requirements of medical colleges, and at raising the general tone of the medical profession. There is no more reason why a nurse, an undergraduate medical student, or an untrained hospital interne, should be entrusted with the life of the patient, as is the case in the giving of an anæsthetic, than that such individual should be allowed to perform a surgical operation which endangers the life of the patient, or to treat a disease the successful culmination of which entails the ability to meet exigencies as they arise.

What has been said with reference to nurses, undergraduate medical students and untrained hospital internes, applies equally to dentists. Babcock has recently reported a death under nitrous oxide and oxygen, administered for surgical purposes by a dentist. Dentists are in the habit of giving nitrous oxide, generally to the point of asphyxiation, for short dental operations, but they should not, unless specially trained, attempt to use this agent, and certainly not others, for more extended surgical procedures.

The element of lack of training in the administration is not the only consideration. It is a well-known fact that nurses sometimes become extremely expert in the administration of a particular agent by a particular method, especially ether by the drop method. So skilful have they become in some instances that it is even claimed that, correctly given, this answers the purpose for all surgical procedures. So long as the cases are suited to this particular method all goes well. The anæsthesia is generally very light, and in abdominal work, where muscular relaxation is required, a very free incision compensates for the lack of depth of anæsthesia.

This, like all other methods, has its limitations, however, and when these are reached the administrator, the surgeon, and the patient are face to face with a situation which may prove detrimental to the welfare of the patient, even, sometimes, to the extent of causing death. No better illustration of the evolution of this wrong principle could be cited than the following: A young surgeon called in a nurse, unqualified with respect to anæsthesia, to narcotize for a short, and as far as life was concerned, an unnecessary operation, when doctors were easily available for the purpose. The patient died in less than ten minutes. The result was a court procedure, and the necessary removal of the doctor to another locality. The point involved is that a healthy subject, twenty-one years of age, about to undergo a very minor surgical operation, which of itself exerted no influence upon the course of the anæsthesia, could have been narcotized without difficulty by an anæsthetist of even a fair degree of skill. The physician in this case gave as his main defence the fact that some of the most prominent surgeons of the day employ nurses exclusively for the administration of anæsthetics.

It should be, and is, the purpose of the American Association of Anæsthetists to combat this state of affairs, and to demonstrate, by fact and figure, by experiment and practice, that it is the inalienable right of the patient who entrusts his or her life to a surgeon to have that life safeguarded in every way possible. The anæsthetist, even more than the surgeon, holds the thread of life in his hands. He should have at his command every facility known to modern science whereby to carry the patient easily into and safely out of the state which has been called " that borderland in which life in many respects so simulates death."

What facilities for the preservation of health, comfort and life, does the present-day anæsthetist command that were unknown to the physician-anæsthetist of old and to the nurse administrator of to-day?

We have already seen that the utilization of combinations and sequences was practically unknown until within recent years. This is one of the facts which renders the modern anæsthetist equal to almost any emergency, and which has helped so materially in the reduction of the mortality statistics as applied to anæsthesia.

Ether, which was formerly given almost exclusively alone, and very largely by the open or drop method, has been materially increased in value by preceding its administration with chloroform or nitrous oxide.

Chloroform, which has played so stormy a part in the drama of anæsthesia, was formerly used alone. It is now conceded that it should never be used alone, or as the terminal anæsthetic, unless especially indicated. It is a safe initiatory anæsthetic to ether when, as preliminary medication, morphine has been administered, the immediate administration being preceded by the inhalation of a few drops of the oil of bitter orange peel.

Nitrous oxide, which was formerly used alone, to the extent of asphyxiation and only in short operations, is now combined with oxygen whenever possible, rendering it safer and making its prolonged administration practical. The combination of nitrous oxide with oxygen, with preliminary small physiological doses of morphine, and a few drops of ether when necessary, is applicable to over 90 per cent. of all surgical cases. Heating the gases by rebreathing or some other method, and the perfection of the apparatus for its administration, are factors which render nitrous oxide and oxygen applicable in a much larger number of cases than was possible by the older methods.

The definite utility of preliminary medication and adjuvant treatment during the administration have materially increased the safety of all anæsthetics and lessened the danger of unpleasant after-effects. Morphine, particularly, may now be counted among the definite facilities by the judicious use of which the skilled anæsthetist can be fairly sure of a safe and satisfactory administration in practically every case. With local and spinal analgesia, intravenous anæsthesia and general inhalation anæsthesia, it is of distinct value. With nitrous oxide and oxygen it materially assists in abolishing reflex phenomena; with ether, chloroform and ethyl chloride it allays psychic and nervous impulses. It should be used unless contra-indicated.

The unpleasant after-effects of inhalation anæsthetics are materially modified by hypodermoclysis, begun with the anæsthetic and continued throughout the operation. Saline solution introduced in this manner maintains the blood-pressure and this assists in preventing shock either from the anæsthetic or the surgical procedure. When hypodermoclysis interferes with the surgical technic an enema of one or two quarts of tap water (which, according to Trout, is preferable to normal saline), with one or two ounces of glucose added, ten to fifteen minutes before the close of the operation, restores the glycogenic function of the liver, fills out the veins, dilutes any anæsthetic which may remain in the blood, and assists in bringing the patient out of the anæsthetic in the best possible condition.

In addition to the foregoing details of technic which give to the anæsthetist employing them unequivocal advantages over the one who is restricted to the use of a given method which must be employed in all cases, certain factors may be brought into play to modify the physiology of anæsthesia as ordinarily induced. Practically every phenomenon varies with the particular anæsthetic agent administered, with the general condition of the patient, with the condition of the blood, and with other variable factors which the anæsthetist should be able to recognize whenever they exist.

Chief among these modifying factors may be mentioned certain ones which represent the most recent and most advanced work of the study of the problems involved in the administration of inhalation anæsthetics: 1, warming the agent; 2, utilizing moisture; 3, combining oxygen with the agent; 4, utilizing carbon dioxide; 5, rebreathing; 6, preceding the administration with the oil of bitter orange peel.

1. *Warming the Agent.*—Since 1905 systematic laboratory experiments and clinical observations have been made to determine the value of the various inhalation anæsthetics, when they are administered cold and when they are warmed to the temperature of the blood. These observations have been made chiefly with reference to: *a,* safety as regards life; *b,* maintenance of body temperature and the consequent lessening of the danger of shock; *c,* recovery from the anæsthetic; *d,* aftereffects.

From the animal experiments with the different anæsthetics, *i.e.,* chloroform, ether and nitrous oxide and oxygen, first at room temperature and then heated to the temperature of the blood, and finally with nitrous oxide and oxygen at 33 to 34° F., it may be concluded that all anæsthetics heated to the temperature of the blood are increased in value as regards life without decreasing their anæsthetic effects.

It has been found by careful experiments and clinical observations, that, whatever may be the cause of the loss of body temperature during anæsthesia, *every fraction of a degree of elevation of temperature* of the anæsthetic agent above that of the room will have a marked effect in maintaining the body temperature of the patient.

Recovery from the anæsthetic is facilitated by the natural inhalation of warmed atmospheric air or of the artificial introduction into the lungs of a current of warmed air. Experimental and clinical observations have abundantly verified these findings with reference to the use of warmed anæsthetics.

Both the immediate and the delayed after-effects of inhalation anæsthesia are reduced to a minimum when the agent is *administered warm.*

2. *Utilizing Moisture.*—Since 1909 it has been my practice to employ warmed *moist* vapors of pulmonary anæsthetics. Baskerville has called attention to the importance of moisture. " It has been shown" he says, " that the administration of moist ether, free from aldehyde, at body temperature, is rarely followed by nausea (less than ten per cent.) and the usual strain upon the kidneys is not observed."

It is to be borne in mind that too high a vapor-saturation acts as deleteriously as too much dryness.

3. *Combining Oxygen with the Agent.*—Carefully conducted experiments and clinical observations have abundantly proved that *oxygen increases the value of all anæsthetics in rendering them safer to the patient* without decreasing the anæsthetic quality.

4. *Utilizing Carbon Dioxide.*—Extensive physiological experiments have established the fact that carbon dioxide is not merely a waste product but performs a distinct rôle as a chemical regulator of various functions. The reduction of carbon dioxide leading to apnœa can be effected by various means detailed by Henderson, as follows: 1, artificial respiration; 2, the hyperpnœa incident to the stage of excitement or of incomplete anæsthesia; 3, the hyperpnœa produced by vigorous stimulation of the efferent nerves; 4, exposure of the abdominal viscera to the air so as to allow a free exhalation of carbon dioxide from the surface of these organs.

Regulation of the carbon dioxide contents of the blood under these conditions appears to Henderson to be the most important factor in the prevention of shock.

Shock experimentally induced was rapidly recovered from when a condition which permitted the tissues and blood to restore their carbon dioxide contents was maintained.

5. *Rebreathing.*—This factor was utilized for many years by professional anæsthetists before being placed upon a firm scientific basis by the laboratory work of Henderson, showing

the necessity of retaining the carbon dioxide in the blood, and the research clinical work of Gatch, establishing the fact that no poisonous element existed in the exhalation of the patient and that the agent moistened and warmed by rebreathing was increased in anæsthetic value as evidenced by the fact that the patient was returned to bed after operation with no loss of temperature and no bad after-effects.

Clinically, rebreathing seems to increase the value of all anæsthetics.

Chloroform—when administered with the Roth Drager apparatus—utilizes rebreathing automatically, and the patient's return to consciousness is as quick and as complete as with nitrous oxide and oxygen.

6. *Preceding the Administration with Oil of Bitter Orange Peel.*—A fact which exerts a striking influence upon the course of anæsthesia is the preliminary administration, by inhalation, of oil of orange (25 per cent. oil of bitter orange peel, U. S. P., with 75 per cent. of alcohol, U. S. P.).

I had long been in the habit of preceding the anæsthesia by the administration of a one per cent. vapor of cologne or whiskey, the agent being placed on the mask.[1] Later oil of bergamont or terpineol for the purpose of masking the odor of ether vapor was used.[2]

Finding the induction period of anæsthesia thus deprived of its terrors for many patients, particularly for nervous women and frightened children, the subject lapsing quietly into unconsciousness when the anæsthetic vapor is turned on, a search was instituted for a substance with a more penetrating yet none the less agreeable odor, which could be vaporized and utilized as a preliminary to ether or other inhalation anæsthetic agent.

The search was practically ended when I read of the experiments of Passy, quoted by Tigerstedt, showing that the odor of the essence of orange is ten times as penetrating as that of ether vapor. There are other things that rank ahead of the oil of orange.

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[1] Gwathmey: "The Vapor Method of Anæsthesia," Med. Rec., October 14, 1905.

[2] Gwathmey: Terpineol (lilacine) serves to mask the odor of ether vapor and is a respiratory antiseptic, but, like oil of sweet orange, is less satisfactory than oil of bitter orange peel because of its very sweet odor.

To these, however, some patients might find objection, whereas, to the delightful odor of the oil of bitter orange peel, it is hardly likely that any one would object.

These observations have been fully verified in thousands of cases in actual practice. When the open method is used, two to four drops of a 25 per cent. solution upon the mask is sufficient. If half a drachm or more is placed upon the mask at one time as has been done by some experimenters, the powerful odor becomes stifling and the stage of excitement is increased rather than modified.

Woolsey, of Brooklyn, developed and perfected the method of employing the oil of orange-ether sequence by the closed method. He has an individual record of over 500 cases. The author and others have used it in as many more. The latest modification is to mix just a little nitrous oxide with the orange odor. It is used wherever the nitrous oxide-ether sequence is indicated but it is to be preferred to this sequence on account of its safety. The patient goes under in practically the same way as with a good nitrous oxide-ether sequence, but with this notable exception—there is no cyanosis at any time. The second stage, so-called, with struggling, etc., is entirely absent.

The pulse is normal, the color reflex good and there is no disturbing mucous râle.

As orange-ether sequence is of comparatively recent development, its physiological basis may not be uninteresting.

The physiological basis for the beneficial effect of the oil of orange in the administration of inhalation anæsthetics may be found in its prevention of reflex stimulation, by the anæsthetic agent, of certain sensory nerves. Dastre[3] attributed early syncope to reflex stimulation of the pneumogastric and trigeminal nerves, particularly the sensory branches supplying the nasal mucous membrane and the larynx. Embley[4] has also emphasized the part played by the increased excitability of the vagus mechanism, particularly during the early part of the administration. In his inhalation experiments Embley found that failure of respiration is mainly due to fall in blood-pressure. With good blood-pressure failure of respiration (his experiments concerned chloroform) is practically impossible. Restoration of respiration is dependent upon restoration of blood-pressure. The chances of dangerous vagus inhibition are greatly increased by imperfect respiration.

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[3] Dastre: "Les Anesthetiques," Paris, 1901, pp. 104-109.

From these findings it would seem fair to assume that any factor which prevents undue inhibition of the nervous mechanism of respiration, and which, by its stimulation of the respiratory centre, prevents fall in blood-pressure, will have a beneficial influence upon the course of the anæsthesia. The oil of orange seems to exert this beneficial influence by dulling the sense of smell to such an extent that the odor of the anæsthetic agent is not noticeable during the administration. It has been determined by our laboratory experiments upon guinea-pigs that the oil of orange exhibits no pronounced anæsthetic effect upon these animals. The exact nature of its physiological action is, therefore, yet to be determined.

The latest development of inhalation anæsthetics is to be credited to Dr. Karl Connell, of Roosevelt Hospital, New York City. It is an evolution of the vapor method.

It consists in delivering a known percentage of ether vapor automatically and is called endopharyngeal insufflation.

Both the volume of air and the exact amount of ether by weight is known. The desired degree of relaxation can be obtained in any surgical case by calling for the desired percentage of ether.

Intravenous anæsthesia has won for itself within the past two years a distinct place in surgery.

The danger with this special form of anæsthesia seems to be limited to infection or embolism and as these two elements are connected with the introduction of the needle and its maintenance in position without injury to the inner mucosa of the vein, this whole procedure should be relegated to the surgeon or the assistant surgeon, the anæsthetist maintaining the anæsthesia by regulating the amount of the saline ether solution into the veins.

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[4] Embley: Brit. Med. J., April 5, 12, and 19, 1902.

A striking illustration of the virginity of the field of anæsthetics in other directions than those touched upon in this paper is the list of over one thousand substances recently compiled under the supervision of Prof. Baskerville (and which will shortly be published) that possess either some general or local anæsthetic property and yet only a small number of these substances have been thoroughly examined.

In conclusion, I may state that the dignity of this special field of medicine can be greatly enhanced and its progress advanced if we urge by every means possible the establishment of the condition so clearly stated by the Committee on Anæsthesia of the American Medical Association for last year as follows:

"Every hospital, certainly every large hospital, should have as a regular member of its staff an attending anæsthetist, as is the case in some, whose authority in his special department should be as complete as is that of the attending physician or surgeon in their field. This arrangement will be particularly important during the next few years when the older methods of anæsthesia will be competing with and greatly modified by newer procedures."

ACCURACY IN ANÆSTHESIA.*

ADVANTAGE, TECHNIC AND DOSAGE IN AUTOMATIC INSUFFLATION OF VAPORS AND GASES.

PRELIMINARY TABLES AND CHARTS OF ETHER ANÆSTHESIA.

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SURGICAL anæsthesia for the half century prior to the past decade made little scientific progress. While the art of anæsthesia advanced with the increasing demands of surgery; while the lore of the individual anæsthetist was accumulated, yet each surgical narcosis was achieved according to the personal recipe of the given anæsthetist. Largely because of the difficulties of confining and measuring matter in such an elusive state as the gaseous, that precision and accuracy of dosage which came to be deemed essential in the administration of liquid and solid drugs, secured no place with the volatile anæsthetics. Anæsthetization was accomplished according to certain empirical methods and formulæ, guided by the reaction of the individual.

Granting that such empiric anæsthetization in the hands of the skilled anæsthetist may be ever so perfect, yet these methods permit of no formulation, uniform results cannot be achieved, nor can methods be standardized. Further, high skill in anæsthesia by these empiric methods involves a rare natural aptitude and long training. Therefore, the trend of the present is toward that exactness of dosage and perfection of delivery, that will place anæsthesia on the basis of an exact science. This dosage in its highest refinement can only be secured by automatic mechanical measurement and delivery.

This has already been achieved with several of the more desirable anæsthetics, notably ether. Indeed, it may be stated that to-day using ether as the agent, a patient may be carried by accurate automatic mechanical insufflation with an even control and a safety and precision that exact mechanical movement alone is capable of effecting, and that already by such means a mass of data has been accumulated that has placed etherization on a thoroughly scientific foundation.

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* Read before the American Association of Anæsthetists, June 18, 1913.

The necessity of accuracy in maintaining a desired anæsthetic tension in the alveolar air is obvious and the many advantages arising therefrom may be briefly enumerated, as: safety, even anæsthesia of desired depth, absolute control over this depth, and marked diminution of subsequent ether intoxication. It is true that such a drug as ethylic ether has a wide margin of safety and both in this form and as ethyl alcohol may be atrociously misused without fatal issue. Yet this misuse is not a fair standard nor should results be accepted as those of properly administered anæsthetic. In gauging the desirability of accuracy the following facts must be briefly stated.

First, the ether tension in the arterial blood to the sensorium is the determining factor of anæsthetization.

Second, this tension is established by maintaining in the alveolar air during preliminary narcosis an ether content of from 35 to 45 per cent. by weight to air under conditions at sea level, an equivalent in pressure of from 130 to 182 mm. of mercury. During the early stage of anæsthesia, say for the first twenty to forty minutes, this tension must be maintained by percentages scaling from 26 down to 15 per cent. After the establishment of anæsthetic saturation of the body it is maintained by about the latter percentage, the equivalent of an ether pressure of 48 millimeters in the alveolar air.

Third, these figures probably hold for the entire animal kingdom, the variable factors seen in ordinary etherization, being these; *a,* the rapidity with which the body is brought to complete anæsthetic saturation, as determined by the efficiency with which the ether tension in the alveolar air is maintained by fresh delivery, by diffusion and by tidal movement; *b,* the rapidity of blood circulation; *c,* the bulk of the particular body to be saturated and the capacity of that body for storage and destruction of the ethyl radical.

Fourth, the zones of anæsthesia above and below this saturation or anæsthetic tension point are already well established for man. With absolute certainty as to the outcome man may be placed in an ether atmosphere of that percentage or vapor pressure as to produce deep, medium or light anæsthesia.

Fifth, the zone of surgical relaxation, *i.e.*, an ether pressure of 45 to 50 mm. is a zone for many hours devoid of danger by ether intoxication.

When one links these evident advantages of a full and continuing knowledge of the dose delivered, with advantage of an even, automatic, unwearying, impersonal machine delivery of the anæsthetic agent and its menstruum, the combination works for ideal anæsthesia.

The accuracy needed for absolute control over the degree of ether anæsthesia, requires that knowledge be continual of the quantity and strength of the anæsthetic mixture delivered. In this apparatus which I now present this control has been secured. Comparable clinical results with other apparatus may be obtained empirically or by physical means, such as by thermal control of the vapor tension of ether, but in this apparatus the control is automatic and the measurement mechanical and mathematically correct. This apparatus has been in use for the past year at the Roosevelt Hospital, New York. It consists of a small portable air compressor, filter and moistener, with a maximum capacity of 50 litres per minute as a source of compressed air. In the hospital we much prefer to this source of air, the noiseless unfailing delivery from a permanent central plant.

To take up the essential instrument, this is the anæsthetometer, an apparatus to mix and measure anæsthetic and other vapors and gases. It consists of these units, a light, powerful, gas meter to measure the air, adopted as the only practical and accurate gas measuring instrument from the illuminating gas industry. This is surmounted by an ether reservoir from which is fed automatically, by the movement of the gas meter, through an adjustable connecting mechanism, liquid ether in any desired quantity, into, third, a vaporizing chamber, warmed by electric stove and provided with thermometer, pressure gauge, instantaneous gas flow gauge and safety valve. The entire control over the percentage of ether resides in the movement of a single pin, whereby any one of sixteen percentages may be obtained with mechanical accuracy, from 2 per cent. up to 27 per cent. of ether vapor in air. Higher percentages are obtained by manual movement of a handle. A fourth feature of the apparatus, is a gas trip valve, whereby any two gases are automatically mixed in mechanically measured proportion, by each in turn actuating the meter. This apparatus has permitted the practical application of measured dose in anæsthesia.

Next to discuss those factors other than accuracy in dosage, which go to make the maintenance of anæsthesia automatic.

For anæsthesia to be maintained automatically, at the same time safely with uniform success, requires that three factors be under the control of the operator or anæsthetist: first, that complete preliminary relaxation of the individual be secured; second, that the anæsthetic agent and its menstruum be so delivered as to be freely available for respiration; third, that the delivery be of such volume as to entirely supply the needs for respiration, as well as of such accurately measured and known percentage or tension of anæsthetic, as to hold a given individual safely and evenly anæsthetized.

Full preliminary anæsthesia is best accomplished by face mask methods since man will not tolerate the introduction of pharyngeal or endotracheal tubes when conscious, nor breathe quietly in the subconscious stage of preliminary anæsthesia the irritating vapors, *i.e.,* 30 to 45 per cent. of ether by weight needed for establishment of complete anæsthesia. These vapors to be inhaled quietly must be inhaled by the subconscious patient in such a way as to arouse no unusual impressions. Attempting to blow vapors of the strength needed for the induction of anæsthesia into the pharynx or trachea, results in straining, coughing, gagging, and the swallowing of air. Only when the patient is completely relaxed can insufflation methods be instituted. This period of face mask delivery occupies six to twelve minutes for the most advantageous relaxation. If the operative procedure is now to occupy more than five or ten minutes, automatic insufflation may be established with decided advantage.

In this, the stage of surgical relaxation, a stage wherein life and death are nicely balanced, the patient is carried by mechanical automatic insufflation with an even precision, a perfect aëration, and a safety which the most conscientious human anæsthetist cannot duplicate.

For delivery to become automatic, the anæsthetic agent and its menstruum must be made freely available for inspiration by the delivery passing the chief obstruction, namely, the base of the tongue. Delivery by face mask requires that the mask be held and the upper gas way of the anæsthetized individual be adjusted by a practised anæsthetist.

In this connection I desire to present a new rebreathing tube, a pharyngeal tube for use in ordinary anæsthesia by face mask. With the insertion of this tube the stertor of ether anæsthesia is quieted, and in gas-oxygen delivery the percentage of oxygen may be materially lowered and the cases carried with lessened danger of sudden asphyxia. It is a flattened copper tube, curved to fit the roof of the mouth, easy of introduction, not harmful to the teeth or soft parts, nor compressible by the bite of the incisor teeth. It provides with the minimum displacement of oral structures, an abundantly free gas channel from the outer world to the lower pharynx. I like it much better than the nasal tubes, or bulky and compressible cylindrical rubber tubes for oral insertion.

To now consider the question of automatic delivery. The ideal place to deliver ether vapor in air is without question directly into the trachea by insufflation through a loose endotracheal catheter after the method of Meltzer. For effective delivery, for complete and certain aeration, for even and controllable anæsthetization, for freedom from shock and from the sequela of ether anæsthetization, this method is not surpassed.

Time does not permit me to elaborate on these nor on the various accessory advantages of this method, namely, the ability to maintain when desired positive pressure on the interior of the lung, and to exclude mucus and other foreign material from the bronchial system, and to maintain if accident arises an ideal artificial respiration.

The one and only hindrance to the establishment of the endotracheal delivery as a routine method of anæsthesia is the act of intubation.

This alone with its possible dangers, its ever present delays and occasional difficulty of intubation will no doubt effectively block the general adoption of this very useful and effective mode of delivery as a routine method of anæsthesia.

In view of the objections to the endotracheal delivery, I have been led to seek a method which would overcome the necessity of intubation and the dangers of a badly supervised delivery, yet preserve the feature most desired for routine anæsthesia, to wit, an automatic, even, accurate, and effective delivery of the anæsthetic agent. In the pharyngeal insufflation method of large volumes of dilute anæsthetic agent deep into the pharynx I believe we have such a method. The delivery is established, after full surgical relaxation has been secured by face mask methods. Speaking now of ether vapor in air delivery, the essential feature of this pharyngeal method, is that a volume of air is insufflated by positive pressure into the lower pharynx, a volume sufficient to provide entirely for each inspiration, without any air being inhaled by nose or mouth, and a volume bearing a known per cent. of ether vapor in the greatest dilution which will hold that patient evenly and safely anæsthetized for the operation in hand.

The delivery is accomplished by preference through two catheters inserted one through each nostril a distance in the average of 12 cm.

The proper distance to insert each catheter is the distance, measured off on the tube from its eyelet, from the auditory meatus to ala nasi on that side. This carries the tube well into the lower pharynx but not into the œsophagus.

The catheters selected for the adult are size 18 F, soft rubber, velvet eye, with accessory eyelet. These are attached to a Y metal delivery tube with bent prongs for convenience of placement and to prevent angulation and to hold the catheters in place. This Y tube accurately fits the nose and forehead and is held in place by adhesive strapped across the brow.

The volume insufflated is such as to entirely supply the needs of inspiration without extraneous dilution. This requires 18 litres of air per minute for the average adult into which is vaporized the ether.

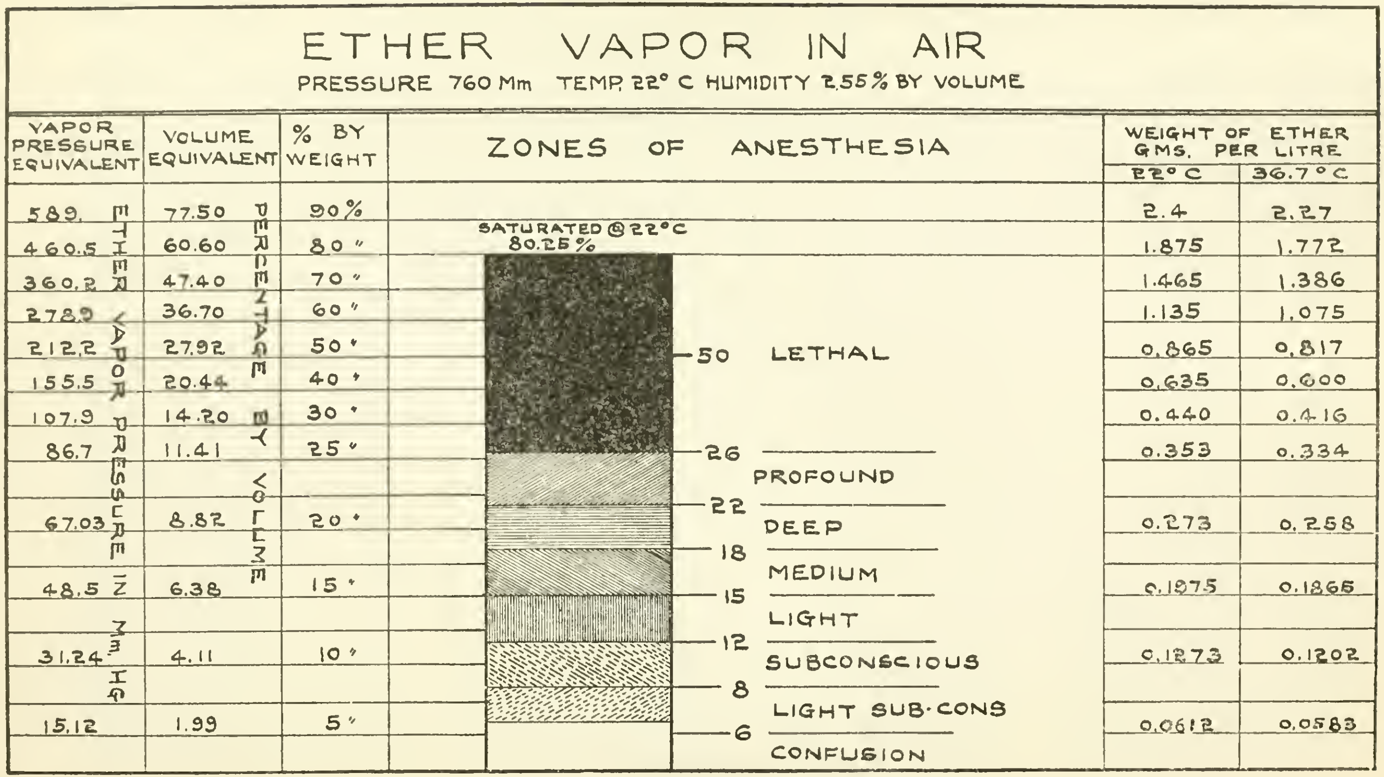
Rebreathing is not contemplated nor countenanced in this method, no more than in the endotracheal.

The evident immunity to shock in patients carried by endotracheal delivery and a clinical comparison of many hundred of these perfectly ventilated patients to those carried by rebreathing, disproves to my mind conclusively the hypothesis that rebreathing is physiologically advantageous.

The element of economy is not worthy of consideration with ether.

However, in nitrous-oxide-oxygen anæsthesia the element of cost enters so strongly that a certain degree of rebreathing may be allowed by the following method: After the patient is surgically saturated with anæsthetic by face mask methods, the delivery is shifted to the pharyngeal method by the nasal route. Each nostril is plugged by a collar of thick rubber tubing slipped over the nasal catheter. A pharyngeal rebreathing apparatus is then inserted, consisting of the flat copper tube previously noted, with a projecting elbow, to which is attached a rebreathing bag fitted with valve escapement at the distal end. The mouth is plugged by a rubber coffer dam, carried on the flat tube. This is adjusted between the gums and lips, making a gas-tight joint. The quantity found most useful is 8 litres per minute beginning with a 5 per cent. oxygen mixture and increasing gradually up to a 9 or 10 per cent. mixture by the end of the first hour. By this volume of fresh gas and with the ease of inspiration resulting from the free gas way, the oxygen content of the gases may be decreased to the depth of 3 per cent. mixture. This percentage is highly dangerous even in large volume automatically delivered, for should delivery fail from

CHART I.



ETHER VAPOR IN AIR

PRESSURE 760 Mm TEMP. 22° C HUMIDITY 2.55% BY VOLUME

VAPOR PRESSURE EQUIVALENT	VOLUME EQUIVALENT	% BY WEIGHT	WEIGHT OF ETHER GMS. PER LITRE 22° C	WEIGHT OF ETHER GMS. PER LITRE 36.7° C
589.	77.50	90%	2.4	2.27
460.5	60.60	80 "	1.875	1.772
360.2	47.40	70 "	1.465	1.386
278.9	36.70	60 "	1.135	1.075
212.2	27.92	50 "	0.865	0.817
155.5	20.44	40 "	0.635	0.600
107.9	14.20	30 "	0.440	0.416
86.7	11.41	25 "	0.353	0.334
67.03	8.82	20 "	0.273	0.258
48.5	6.38	15 "	0.1875	0.1865
31.24	4.11	10 "	0.1273	0.1202
15.12	1.99	5 "	0.0612	0.0583

any cause the respiration ceases from asphyxia, promptly. Percentages less than 6 per cent. while necessary for surgical relaxation are dangerous. In fact, the necessity for any percentage which produces noticeable cyanosis after the first five minutes of administration should brand nitrous oxide for that operation as a most dangerous method for producing surgical anæsthesia. Where surgical relaxation is desired and protection against subconscious suffering is indicated this is to be obtained, not by dangerously increasing the oxygen starvation, but by the safer, more effective means of adding ether as indicated.

I desire to emphasize that rebreathing is used solely for economy. On a pharyngeal delivery of 22 litres or five and one-half gallons a minute rebreathing may be dispensed with if the mouth be kept closed.

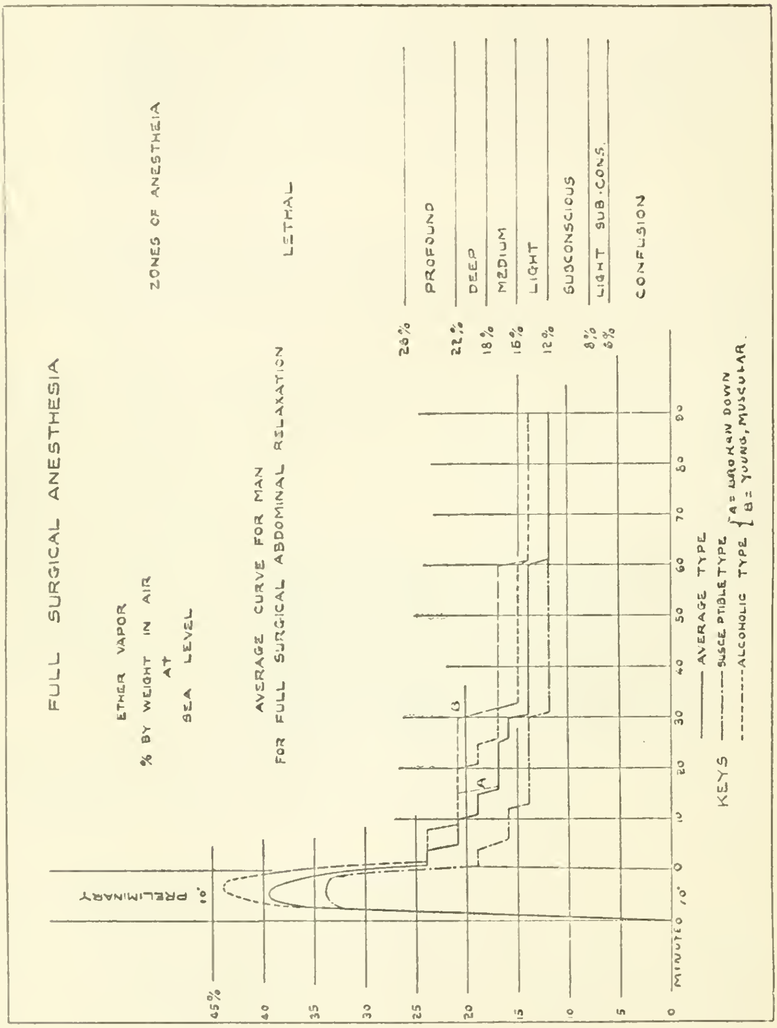
In summary. The pharyngeal method as carried on by the technic developed on about five hundred cases at the Roosevelt Hospital, is a method I believe that combines most of the advantages of endotracheal delivery; a method much more simply achieved and devoid of the mechanical dangers that are present in endotracheal insufflation, at the same time admitting freely, however, that the method is not so thoroughly effective in control over aëration or over positive pressure, nor so effective in excluding foreign material from the larynx as the endotracheal delivery.

I venture the prophesy that the pharyngeal method of delivery will be the routine method of the future when an automatic, thoroughly controlled, ideal anæsthesia is desired through the stage of surgical relaxation.

I desire to present these charts of ether anæsthesia based on our experience with the anæsthetometer at Roosevelt Hospital. These zones and curves do not vary materially, no matter what method of delivery be employed, providing there be no dilution. The one variable, is the time and difficulty of establishing complete anæsthetic saturation, otherwise I believe these zones and curves are basic for animal protoplasm.

Chart I indicates the zones of ether anæsthesia in terms of weight of ether to air delivered under working conditions. The volumetric equivalent, and ether vapor pressure equivalent, is tabulated in parallel column, as is the absolute weight of ether per litre in the air at delivery and at body temperature.

CHART II.



These zones are for practical working guidance in surgical etherization and are not absolute. The zones above the 15 per cent. level, gradually lower toward that level as the anæsthetic tension of about 48 millimetres of the entire body is attained. At the end of an hour of full anæsthesia, even the zone of deep anæsthesia for a considerable length of time might result lethally. For example, when a dog, after anæsthetic saturation, is carried in the zone of profound anæsthesia by endotracheal delivery, respiratory effort ceases in about an hour, only to begin again when the ether tension is lowered. Such dosage would have resulted fatally had provision not been made for artificial respiration. These zones are the same whether the delivery be by face mask or by insufflation.

Chart II shows the most advantageous ether pressure to maintain in the pulmonary air, charted in terms of weight of ether in air under usual working conditions at sea level.

This is a composite of about 300 cases of surgical anæsthesia at the Roosevelt Hospital, charted after a working experience had been gained on a previous series of about 600 cases.

The percentages above 15 per cent. during the preliminary and early stage of full surgical anæsthesia, are needed to establish the proper anæsthetic tension in the arterial blood to the sensorium, pending such time when the entire circulating and fixed tissues of the body are brought to uniform tension. As seen on the chart there is a difference of 20 to 30 minutes between the length of time such saturation takes in a man of the young robust or alcoholic type, to the much shorter time taken to saturate the small relaxed woman and child. All types, however, when the general tension is once established, run on the same base line. This, for complete anæsthesia, is between 14 per cent. and 16 per cent. by weight of ether, yielding a tension between 45 and 51 millimetres. The absolute point is not as yet fully established but is probably about 48 millimetres. In fact it would seem from preliminary observation that this tension is basic not alone for all types of man, but also for the entire animal kingdom. Below this level the operative case may be carried where only light anæsthesia is desired, or when the operation reaches such a stage that protection against shock influence is no longer needed *i.e.,* that very effective protection conferred by full ether anæsthesia, or where the anæsthetist desires the patient to enter the zone of slow ether desaturation and recovering consciousness. This recovery zone may be so gauged that in short operations the patient leaves the table practically conscious, and even after long operations in full possession of all pharyngeal reflexes.

Saturation of the arterial blood and sensorium is complete in the curve shown, to the extent of full surgical anæsthesia, in about two minutes for each litre of circulating blood, being complete in medium-sized children in six minutes and in the adult in twelve minutes. Operations, even major procedure, may be begun before full relaxation is established or at the peak of the preliminary curve, say at the end of six minutes in a docile adult. Yet where it is desired to fully protect the patient against shock producing and inhibitory influences it is desirable to wait for full surgical relaxation, *i.e.,* about 10 to 12 minutes.

While the arterial blood to the sensorium may be fully charged by high percentages within ten minutes, yet the general body of an adult is not brought to full tension approximating 48 millimetres, by the delivery curve shown, for from forty to sixty minutes. Desaturation proceeds even more slowly, although marked changes of deadened or awakened sensibility may be seen within three minutes by increase or decrease of ten millimetres of ether vapor pressure in the air delivered. This sensitiveness is more pronounced before the anæsthetic tension of the entire body is established. Partial recovery is more rapid than deepening anæsthesia by changes of equal degree before saturation is complete. After the anæsthetic tension is established, anæsthesia may be more rapidly deepened than diminished, an observation readily explicable on physical and chemical grounds.

With these basic facts in mind, and with experience in gauging the difficulties which may arise in bringing a given individual to saturation and in planning the desaturation of that individual according to the period and need of the operative procedure, the most advantageous anæsthesia can be plotted in advance with exactness.

In closing I desire to make a plea for accuracy of dosage and for automatic delivery in anæsthesia, particularly in the stage of prolonged surgical anæsthesia.

By full knowledge of the quantity and dilution of the anæsthetic delivered, and the resultant anæsthetic percentage maintained in the respiratory tract, the whole control of the subject of anæsthesia lies in the hollow of the anæsthetist's hand.

The patient may be carried in the zone of profound anæsthesia, or deep, medium, or light anæsthesia at will. With the data at present in hand the most advantageous anæsthetization by ether can be plotted in advance for the type of individual and for the nature and stage of the operation, and maintained after the initial stage entirely automatically and, were it desirable, without the presence of any anæsthetist. The ether intoxication may be reduced to a small factor and shock influence effectively blocked.

It may be confidently anticipated that similar data will soon be available for the other gaseous and volatile anæsthetics.

CONCLUSIONS.

1. Accuracy should prevail with the volatile anæsthetics, as with liquid and solid drugs.

2. The content of drug per unit of alveolar air is the gauge of dose, expressed scientifically in terms of vapor pressure.

3. Such dosage is practicable by the anæsthetometer, an apparatus to measure and mix anæsthetic and other vapors and gases.

4. The advantages of accurate dosage are toward better induction and safer, more effective maintenance of any desired degree of anæsthesia.

5. The dose should suffice in volume to supply the tidal capacity of respiration.

6. The vapor tension of ether required by man is constant. This tension is probably basic for all animal protoplasm. The attainment and maintenance of ether anæsthesia may be plotted in advance.

A curve of ether pressure required in the alveolar air, plotted for the most advantageous etherization in man rapidly ascends in the preliminary stage to 130 to 182 millimetres or 35–45 per cent. by weight of ether to air at sea level pressure. After five minutes the curve falls, reaching 26 per cent. by the tenth minute when surgical relaxation becomes well established. Through the next half-hour the curve scales downward reaching 15 per cent. or a pressure of 48 millimetres by the thirtieth or fortieth minute. On this as a base line it runs for many hours, man of every type remaining in even, safe narcosis. The pressure must be decreased when the zone of light anæsthesia or the zone of full consciousness is desired to be entered.

7. The best delivery is by mechanical insufflation of an automatically mixed and measured dose.

8. The most feasible insufflation is deep into the pharynx.

9. The most effective insufflation is into the trachea.

I desire to express my indebtedness to Dr. Walter Boothby, who, working with the same instrument at the Brigham Hospital, Boston, has checked and controlled these curves and zones, and has formulated the concept of ether anæsthetic tension, and has through wider experience in prolonged ether anæsthesia established that the base line of anæsthetic tension continues through the third and fourth hour of ether anæsthesia on man at a vapor tension of 48 millimetres.

REFLEX ACTION DURING GENERAL SURGICAL ANÆSTHESIA.*

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Most text-books and the current literature on anæsthesia contain meagre articles on the subject of reflexes that relate to surgical narcosis. Perhaps the writers consider that the subject properly comes under general physiology, but as a matter of fact there are so many important reflexes which are intimately associated with surgical anæsthesia that the subject should be given special study, investigation, and prominence by anæsthetists. By a thorough knowledge of the physiological phenomena presented by the behavior of reflexes, we are enabled to determine the depth of anæsthesia and consequently to regulate the dosage of anæsthetic agents. Reflexes are to a great extent guides as to the condition of the patient.

A reflex act (*re,* back; *flectere,* to bend), is an act following immediately upon a stimulus without the intervention of the will (Gould). For the production of a reflex act, three essential anatomical and physiological factors are necessary: first, an afferent nerve to receive and transmit the stimulus; second, a nerve cell centre or centres in the gray matter to receive, register, transfer, initiate, and transmit; third, a centrifugal efferent motor impulse to a muscle. This in brief is the mechanism necessary for a reflex action and constitutes what is known as a reflex arc. A suitable example of a reflex act is closure of the eyelid immediately when the conjunctiva is irritated.

In the general physiology of reflex action the reactions are divided into simple reflexes, co-ordinated reflexes, and convulsive reflexes; or partial reflex, widespread co-ordinated reflex, and widespread inco-ordinated reflex. Considered from an anæsthetist's point of view, in order to determine the degree of action of narcotic drugs on the body, a specific classification is necessary; which I have arranged as follows:

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* Read before the American Association of Anæsthetists, June 18, 1913.

Reflexes of the Eyelid: Cutaneous; ciliary; conjunctival; double conjunctival.

Reflexes of the Eye: Tarsocorneal; ciliocorneal; corneal; pupillary, including: *a,* reaction to light, *b,* marginal motility, *c,* crossed concomitant, *d,* ciliospinal or platysma.

Reflexes of Air Passages: Nasal; pharyngeal; laryngeal; palatal; rhythmical variations of respirations.

Rectal and vaginal.

Reflex cardiac and respiratory inhibition.

Reflex cardiac and respiratory acceleration.

Miscellaneous, as cutaneous in general, abdominal, peritoneal, labiomental, vomiting, direct motor.

Following is a brief description of the above:

REFLEXES OF THE EYELID.

Cutaneous.—During analgesia, or very light anæsthesia, if the integument covering the upper eyelid is rubbed by the point of the finger, an afferent impulse is transmitted along the infratrochlear to the nasal nerve, which is a branch of the ophthalmic division of the trifacial (fifth) nerve. This impulse is transferred in the gray matter and an efferent motor impulse is sent back by the facial nerve to its terminal branches, which are the temporal and malar, and cause a contraction of the orbicularis palpebrarum.

Ciliary.—This reflex is practically the same as the eyelid cutaneous, except that the sensory irritation is produced by brushing the eyelashes, and the irritation is also taken up from the lower lid by the palpebral branches of the infra-orbital of the superior maxillary of the fifth nerve. It is of value in light nitrous-oxide-oxygen anæsthesia.

Conjunctival.—Irritation of the conjunctiva causes an impulse to be taken up by the infratrochlear and palpebral branches of the trifacial nerve, which is reflected to the facial nerve and causes contraction of the orbicularis, or a portion of it.

Double Conjunctival.—This reflex is the same as the conjunctival, except that both lid margins are stimulated at the same time. The afferent nerve terminals are separate and a greater "signal surface" is irritated. This reflex is of practical value during gas-oxygen analgesia or anæsthesia.

REFLEXES OF THE EYE.

Tarsocorneal (Parsons' reflex).—I wish to elaborate on this particular reflex because for eight years I have been investigating the anatomical, histological and physiological phenomena concerned in its production, and also its clinical application. So far as I am aware, this specific reflex has never been described except by myself, in 1907 (*Denver Medical Times,* August, 1907, p. 40). This reflex is produced as follows: The superior palpebral portion of the orbicularis is gently retracted upward by the anæsthetist's index, or preferably the middle finger, and by steady pressure the ciliary margin of the tarsal plate is pressed against the cornea directly over the pupil. The reaction which follows is a lateral movement of the lower lid toward the nose. To understand this particular reflex definitely, it should be considered from an anatomical, histological and physiological stand-point:

(*a*) *Anatomy.*—It will be remembered that the orbicularis palpebrarum is a sphincter muscle with its tendinous portion, including the tendo oculi, situated at the inner angle of the orbit. The muscle itself consists of two distinct portions, *i.e.,* the palpebral portion (ciliaris) covering the eyes, which is thin and pale and possesses involuntary action; and the orbicular portion (orbicularis latus) which is thick and of a reddish color and surrounds the orbit. Another distinct muscle, the tensor tarsi (Horner's muscle), a small thin muscle which arises from the orbital surface of the lachrymal bone and is inserted into the tarsal plates, plays an important rôle in this reflex. The nerves concerned are the long ciliary nerves of the cornea from the nasal branch of the trigeminus, the short ciliary branches from the ciliary ganglion, the temporal and malar branches, and the infraorbital branch of the facial, the last inervating the tensor tarsi. The superior tarsal plate is composed of dense connective tissue and is about one-third of an inch in breadth at the centre. The free or ciliary margin is thick and presents a perfectly straight edge. The inner angle of the plate is fixed to the margins of the orbit by the tendo oculi.

(*b*) *Histology.*—The cornea consists of a number of layers, the anterior being of stratified nucleated epithelium connected by delicate processes of protoplasm. Beneath the epithelium is a network of non-medullated nerves (from the ciliary) known as the subepithelial plexus, which branch into naked fibrillæ and ramify between the epithelial cells, the intraepithelial plexus, and terminate as minute fibres with spherical end bulbs, which are exceedingly sensitive.

We now come to a physiological consideration of the tarsocorneal reflex and its clinical application. When the straight edge of the tarsal plate is pressed against the cornea, its sensitive nerve endings are irritated and a centripetal afferent impulse is conducted by the trifacial nerve to the gray matter, is there transferred and a motor impulse is sent back *via* the facial nerve to muscles which cause a lateral retraction of the lower eyelid toward the nose. A mesial contraction of the orbicularis is inevitable because the tendinous structures are situated at the internal aspect of the orbit. Also the tensor tarsi on contraction pulls the tarsal cartilages inwardly especially the inferior plate.

Variations in the reflex action are due to many causes. Narcotic drugs will diminish the excitability of the reflex arc. Neurotic individuals present an active reflex. Repeated attempts to elicit the reflex will cause fatigue and consequently a diminished or no reaction. When Horner's muscle is very indistinct, as it occasionally is, the strength of the reflex is diminished.

Lastly, the amplitude and activity of the tarsocorneal reflex diminishes directly as the depth of anæsthesia, and is therefore a valuable anæsthetic guide. The retraction of the lower lid in surgical anæsthesia (third stage) may only be 1/64 of an inch in amplitude. This reflex is practically as sensitive as the direct corneal produced by touching the cornea with the finger tip—a practice which is non-surgical.

Ciliocorneal Reflex.—This reflex is produced by causing the eyelashes of the upper lid to touch the cornea. The reaction is the same as the tarsocorneal or corneal.

Corneal Reflex.—The corneal reflex is essentially the same as the tarsocorneal, except that the afferent impulse is produced by direct irritation of the delicate corneal surface, usually by the point of the finger. It is bad practice to induce the reflex in this manner, as a number of corneal inflammations and ulcers have resulted from this procedure.

Pupillary Reflex Action.—The pupillary reactions are extremely valuable guides as to the condition of the patient during anæsthetization. In some cases the pupils are so modified by drugs, type of patient, etc., that they lose their full value as guides, but even then if interpreted correctly they serve as definite indicators of the effect of the anæsthetic.

(*a*) *Reaction to Light.*—When the lid is opened and the eye exposed to light, the pupil contracts. The light irritates the retina, which sends a centripetal impulse to the brain *via* the optic nerve, the efferent channel being the third nerve (ciliary ganglion and short ciliary nerves) which causes contraction of the iris. Patients with an Argyl-Robertson pupil do not react to light during narcosis, but marginal motility is present.

(*b*) *Marginal Motility* (Described by J. B. Morrison, *N. Y. Med. Jour.*, 1898).—During surgical anæsthesia if the eyelids are retracted and the eyes exposed there is seen an alternate non-rhythmic contraction and dilatation of the pupils. This is due possibly to a physiological battle between the third nerve, which contracts, and the irritated sympathetic (from operative manipulations) which dilates the pupil.

(*c*) *The crossed concomitant* pupillary reflex is produced by keeping retracted the upper eyelid of one eye while the lid of the other eye is alternately opened and closed. The pupil dilates in the exposed eye when the lid of the opposite eye is closed, and contracts when the lid is opened. This bilateral phenomenon is dependent upon the decussation of the optic nerves, and upon the activity of the reflex the depth of anæsthesia is based.

In the lighter stages of anæsthesia, the pupils are reflexly dilated from various afferent causes. During surgical anæsthesia (third stage) the pupils are contracted (unless modified by drugs, or in the persons of neurotic subjects) due to the predominating influence of the third nerve, the afferent impulses being held in abeyance to a great extent. If for some reason the patient enters the fourth stage of anæsthesia, paralytic (passive) dilatation of the pupils occurs. The differential diagnosis between physiological reflex dilatation and pathological paralytic dilatation of the pupils is given in the following table:

REFLEX DILATATION.	PARALYTIC DILATATION.
Pupil is bright, mobile, liquid, life-like hue.	Pupil is dull, sluggish, immobile, death-like condition.
Other reflexes usually present.	No reflexes of any sort present.
Patient shows signs of "coming out."	Entire body relaxed.
Marginal motility of the iris is present.	No marginal motility is present.
Eye-balls may roll.	Eye-balls are fixed.
Reaction of pupil to light.	No reaction of pupil to light.
Not enough anæsthetic has been given, determined by clinical experience.	Too much anæsthetic has been given, or not enough, resulting in reflex cardiac inhibition.
Respiration and circulation in fair condition.	Respiration and circulation failing.
Skin has good color.	Skin is cold and clammy; pallor or lividity.
Eyelids usually closed.	Eyelids remain partly open, due to relaxation.
Tonicity of eyelids is present.	No tonicity of eyelids.
Tears are not markedly secreted.	Increased secretion of tears.
More anæsthetic will contract the pupil (third stage).	More anæsthetic will produce still wider dilatation, plus respiratory and cardiac arrest.
Less anæsthetic will cause pupil to remain large (reflex dilatation).	Less anæsthetic, or none, will cause the pupil to contract back to third stage.

(*d*) The *ciliospinal* or platysma reflex is of value to determine false or spurious anæsthesia. Very often when children inhale a few breaths of anæsthetic vapor (chloroform usually) they pass at once into a natural sleep. The pupils become exceedingly small, the lid reflexes are absent, the lower jaw is relaxed, the respirations are quiet, there is general muscular relaxation, and the patient appears as if in deep anæsthesia. If an incision were made at this time the patient would cry out and immediately be wide awake, or a reflex cardiac inhibition might occur, which might prove fatal, especially if chloroform were being used. To determine this state of pseudo-anæsthesia, the patient's neck (platysma myoides) is pinched or tapped with the fingers and a pupillary reflex dilatation takes place, indicating more anæsthetic. The reflex in this case is caused by stimulation of the ciliospinal centre, which controls the dilatation of the pupil. This centre (Budge's ciliospinal centre) is situated in the lower cervical region, extending downward to the level of the first to third thoracic nerve.

REFLEXES OF THE AIR PASSAGES.

These reflexes occur during the lighter stages of anæsthesia.

The *nasal* reflex is sneezing when the schneiderian membrane is irritated by a too concentrated anæsthetic vapor.

The *palatal* reflex causes gagging and swallowing movements, and often leads to vomiting.

The *pharyngeal* reflex occurs when the pharynx is irritated, the reaction being swallowing movements, or gagging.

The *laryngeal* reflex is coughing, caused by irritation of the fauces, larynx and neighboring structures.

Reflex inhibitions may also occur from this site.

" Crowing " breathing may be reflexly excited by manipulations of the surgeon in abdominal operations.

The " expiratory phase of Crile " is a grunting expiration during operations within the upper abdominal cavity, and the " inspiratory phase of Crile " is a noisy inspiration during operations in the lower abdominal cavity.

Of especial clinical interest is spasm of the glottis, with complete closure of the rima glottidis, produced reflexly by irritating vapors, usually ether, and often occurs during fairly deep anæsthesia. The stridor may persist and tongue traction be of no avail. Laryngotomy or tracheotomy may be necessary in obstinate cases. Spasm of the glottis also may be produced reflexly by afferent impulses from various parts of the body, as from the perineum. Rhythmical variations of the respiratory act may occur reflexly from various centripetal impulses, produced by the operative procedure and are of three types, viz: those that accelerate and those that inhibit respiration, and those that cause intermittent breathing.

Rectal Reflex or Anorespiratory.—When the rectum is dilated, the reaction produced is a sudden inspiration. The same obtains when the vagina is dilated. In any case that has entered the fourth or paralytic stage of anæsthesia, dilatation of the sphincter ani often sets the respiratory pump in action in conjunction with other means of resuscitation.

REFLEX CARDIAC INHIBITION.

Under this heading a few important considerations relative to anæsthetics will be taken up. When a patient is in incomplete anæsthesia (particularly during chloroformization) the heart is especially susceptible to reflex inhibition, and if during this stage operations, even trivial, are begun the heart action may be arrested, and, indeed, many deaths have occurred in this manner. The principle causes of this dreaded phenomenon are afferent impulses acting reflexly upon the inhibitory fibres of the vagus; fear; irritating fumes of a concentrated chloroform vapor acting reflexly upon the sensitive mucous membrane of the air passages; directly by sudden anæmia of the medulla. Reflex cardiac inhibition is prevented by the preliminary use of atropin (this drug augments the heart beats by paralyzing the inhibitory mechanism); by a gradual administration of the anæsthetic with plenty of air; by having the patient in the third or surgical degree of anæsthesia; and by keeping the intracardiac pressure up to par. Clinically, reflex cardiac inhibition occurs most frequently when very sensitive areas are irritated, as operations about the distribution of the fifth nerve; laryngeal operations; circumcision; avulsion of the finger or toe nails; curetting a sensitive cervical canal. Care should be exercised in using the faradic current about the vagus and its branches.

REFLEX CARDIAC ACCELERATION.

The centre for the augmentor nerves of the heart is probably situated in the bulb. Stimulation of afferent nerves in the lighter stages of anæsthesia causes a more rapid heart beat by reflexly stimulating the sympathetic nerves of the heart (providing reflex inhibition does not occur) the augmentor centre ordinarily being more easily excited than the inhibitory. The comparative pulse rate during anæsthesia is an indicator of the depth of narcosis.

REFLEX RESPIRATORY INHIBITION AND ACCELERATION.

The same general rules apply to the respiratory action as for the cardiac action, but to a lesser degree. During the surgical procedure the pulse and respiration vary in rate, more fluctuation being present during the lighter stages of anæsthesia.

MISCELLANEOUS REFLEXES.

General Cutaneous.—If the patient is too lightly anæsthetized and an incision is made, flinching occurs and disaster may result from reflex cardiac inhibition, especially when using chloroform.

Abdominal-Peritoneal.—The parietal peritoneum is a sensative " signal surface," and deep anæsthesia is often necessary to overcome the reaction, which is a rigid abdominal wall. With nitrous-oxide-oxygen anæsthesia this reflex is the surgeon's bane, but relaxation can be greatly overcome by proper technic.

Labiomental Reflex.—Dastre discovered a reflex which he termed labiomental or " ultimum reflex." He found that by irritating the upper gum (in dogs) a reflex retraction of the lower lip occurred. Perhaps this led to the well-known and valuable lip-friction, which reflexly stimulates respiration (labiorespiratory reflex). Brisk rubbing of the lips often prevents threatened anæsthetic syncope from becoming fatal.

Vomiting during anæsthesia occurs only during the lighter stages and is due to a number of causes. Ankle clonus, ether-tremor, and exaggerated knee-jerk when present are exhibited during the second stage, but had best not be classed as true reflexes.

No doubt there are many other reflex phenomena concerned in surgical anæsthesia, and it is the hope of the writer that continued scientific investigation will be conducted in this field by anæsthetists.

INTRAVENOUS ANÆSTHESIA.*

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The exacting demands of both operator and patient in the surgery of the present day have taxed the skill and resources of the expert anæsthetist to the uttermost limits and have caused him to explore all fields which give any promise of anæsthetic possibilities. The layman, with a somewhat exaggerated idea of the safety of modern surgical operations, usually disregards the potential factor of danger present in all operative procedure but invariably seriously considers the probable risk from the administration of an anæsthetic. The surgeon insists upon a period of stable anæsthesia of indefinite duration, with complete relaxation of the musculature of the patient, minimum risk, freedom from postanæsthetic nausea and vomiting, and finally the absence of those more serious complications of the post-operative stage, which are now believed to be the direct result of the narcosis. These post-operative complications, which may be immediate or remote, have been very closely studied and are variously supposed to be the direct irritating effects of the narcotizing agent—in some cases amounting to actual degeneration of tissues with a more or less constant and definite pathological picture. Crile's wonderful observations and experiments, conducted with a scientific acumen and judgment amounting to a veritable inspiration, have set other standards and have established principles that introduce an entirely new era in anæsthesia. He has demonstrated, beyond the shadow of reasonable doubt, that during operations conducted under the usual methods of ordinary inhalation anæsthesia, traumatic impulses from the operative field are constantly bombarding the cerebrum, that the tissues, nerve tracts and portions of the sensory portion of the brain, are keenly awake and alive to these harmful associations, and that the subjective mind is not narcotized,—only imprisoned. Furthermore, that the involuntary struggles of the patient not deeply anæsthetized, and which have always been considered simply reflex and without importance except to indicate the necessity of more anæsthetic, are in reality motive efforts on the part of the patient to escape the operative trauma, such movements, excited by irritation, being a heritage of experiences from the patient's phylogenetic ancestry.

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* Read before the American Association of Anæsthetists, June, 1913.

It has long been known that the vasomotor, cardiac and respiratory centres in the medulla discharge nervous energy in response to stimuli applied to various sensitive portions of the body during surgical anæsthesia. If the trauma is sufficient, exhaustion of the entire brain is observed after the anæsthetic effects have worn off, that is, despite complete paralysis of voluntary motion and loss of consciousness, due to ether, the traumatic impulses reach the wide awake centres in the medulla and also in every other portion of the brain. If, however, the nerve tracts from the field of operation be blocked with cocaine, and the element of fear be excluded, despite the intensity or the duration of the trauma within the operative zone so blocked, no exhaustion follows after the effects of the anæsthetic have worn off and no degeneration is apparent in the brain cells. It is therefore manifestly clear that ether, by inhalation, is but an "anæsthetic veneer" which, while it produces unconsciousness, apparently protects none of the brain cells against the trauma of a surgical operation.

This proposition, it is claimed, explains why, in the employment of the usual methods of inhalation anæsthesia, a robust patient may go to an operating room for an operation of an hour's duration, to emerge beaten, broken and shattered, and in such condition that months, or even years, may intervene before he recovers his normal status of health. The operation of these injurious impulses during surgical procedure Crile calls "noci-association," and that state which he obtains by employing certain methods of nerve blocking to prevent these traumatic impressions from reaching the cerebrum, he calls " anoci-association."

From the foregoing, it is evident that progress in anæsthesia, whether it concerns method or agent employed, must incorporate in its possibilities all of the factors concerned in the production of anoci-association. We are strongly of the opinion that no method, however much it has to commend it, will not meet the new standard set by Crile unless by its employment the patient is anæsthetized quickly and pleasantly, that is without the sensation of suffocation or strangling and with the absence of a stage of excitement. The patient should pass into a narcosis closely simulating normal sleep, should be completely relaxed so far as the muscular system is concerned and, during a long and even trying operation, the pulse and respiratory wave should be subject to very little variation; the patient should awaken promptly after the operation, there should be no nausea or vomiting, comparatively little or no post-operative pain, no unpleasant after-effects of any kind that leave disagreeable memories on the mind of the patient. These are the advantages claimed by Crile when he employs gas and oxygen anæsthesia with nerve blocking from the operative field with urea and quinine hydrochloride. These conditions may be duplicated with intravenous anæsthesia with even some additional advantages. In the preliminary reports of our experiences we were careful to explain that this method would have, in all probability, a comparatively restricted though definite field of usefulness, but its continual employment, not only in private practice but in a hospital where the anæsthetic risks are probably greater than anywhere in this country, has surpassed any form of anæsthesia ever employed in the institution.

Like many discarded or forgotten surgical procedures which, when revived, interest the medical profession by the charm of apparent novelty, general anæsthesia by the intravenous route was demonstrated as a possibility by Orè, in 1872, who used chloral hydrate as the hypnotic agent and whose report (published that year) covering every detail of his experiences, is of extreme interest. He had considerable success in 51 cases but after a few fatalities, due perhaps both to the method and the drug employed, he discontinued its use. In 1909, Burckhardt, after extensive animal experiments, became enthusiastic over the intravenous method and attempted its use on the human subject, using chloroform at first but soon discarding it for ether, which he found quite as efficient, and much safer. At the Berlin Surgical Congress in 1910, six surgeons of prominence corroborated the success of Burckhardt, Kummel reporting 90 cases in his own experience, believing that it was particularly useful in aged and cachectic individuals.

Later, Fedoroff of St. Petersburg collected 530 cases from 3 Russian clinics, in which hedonal had been used in the same way and, although the cases embraced all kinds of surgical operation, there were no deaths attributable to the anæsthetic. Eight cases of temporary respiratory arrest, however, yielded to simple methods of artificial respiration. Up to this time, the method of induction of anæsthesia in this manner was somewhat crude, as Kummel pointed out, not free from danger, particularly of thrombosis. Burckhardt employed a simple infusion apparatus from which a mixture of a 5 to 7.5 per cent. of ether in normal saline solution was allowed to flow through a cannula into a convenient vein, usually the median basilic, until a sufficient narcosis was established to proceed with the operation. The flow was stopped by compression of the rubber tube, connected with the cannula, until the patient began to show signs of returning consciousness, when the solution was again admitted to the circulation, and so on until the operation was completed. Fedoroff and his colleagues used a 0.75 per cent. of hedonal in normal saline solution, in much the same way except that the cannula was entirely withdrawn from the vein to be reintroduced into a fresh one when more anæsthesia was required. Kummel sought to obviate the danger of thrombosis by providing two tanks, one with normal saline and the other containing the anæsthetic solution, both being connected with appropriate control stop-cocks and a Y-connection so that, even though the anæsthetic solution was cut off, the normal saline flow could be continued, and thus the circulation in the vein at no time be absolutely stopped. This method did not give a smooth, even anæsthesia and finally Rood devised a most ingenious apparatus, safe, simple, and efficient, which has answered all the requirements for maintaining a continuous, easily regulated flow, which may be kept at a uniform temperature, and places the degree of narcosis quite within the easy control of the anæsthetist.

We have constructed such an apparatus, largely from materials at hand, with a justifiable spoliation of some of our other equipment, which has embodied all of the essential features of Rood's valuable suggestions, so that the use of this method of anæsthesia does not necessitate a very expensive outlay (see Fig. 1).[1]

It should be understood at the outset that this procedure is not urged to supplant any of the well recognized forms of anæsthesia in general use, nor do we entertain the hope or belief it will become the method in universal use. We are convinced, however, that, with further experience and development, its efficacy and safety will assign it a definite field of usefulness. In the generally employed method of respiratory anæsthesia, some volatile agent is introduced into the circulation by way of the lungs, the rate of introduction being affected by certain variable factors, the energy and depth of the respiratory effort, laryngeal and respiratory spasm, the condition of the bronchial mucous membrane, and the skill of the anæsthetist. There are, of course, many other conditions which modify the amount of anæsthetic required to produce surgical narcosis in a given subject, but those mentioned are present as variable factors in every case where the indirect or respiratory method is employed. It is manifestly clear that, under these conditions, in every case of anæsthesia produced in this way, more of the anæsthetic is introduced into the body than is necessary, the excess is stored up in the tissues to be gradually eliminated, a matter of several days duration, with often the unpleasant, if not serious consequences, which mark the toxic effects of the drug employed. The delayed effects of anæsthetics, after narcosis and after the patient has recovered from the shock, and other more or less immediate results of the operative procedures are worthy of closer and more extended study. It is reasonably certain, in the minds of most observers, that acute yellow atrophy of the liver (or a poisoning of the hepatic cells and interference with their metabolic activity), injuries to the myocardium, and the developments of a state of acidosis allied to diabetic coma, are occasional late sequences of chloroform administration. The well-known irritating effects of ether upon the respiratory apparatus and the kidneys are well understood. The evil effects of any anæsthetic do not depend upon the amount taken into the lungs but the amount absorbed from them by the blood, and again the amount absorbed by the tissues from the blood, and especially those tissues of the nervous system which are intimately associated with vital functions.

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[1] The Kny-Scheerer Co., of New York, has made a very satisfactory apparatus, after our designs, for intravenous infusion anæsthesia.

It must be borne in mind, as pointed out by Buxton, that, if the administration of an anæsthetic is kept at the same level, narcosis will deepen, and if the anæsthetic is a stimulant, such as ether, the initial stimulation of the nervous system gives rise to an ever-increasing exhaustion. If the anæsthetic is a depressant, such as chloroform, its maintenance at the same level of strength will turn depression of function into profound exhaustion. However slight may be the degree of respiratory failure, it leads to diminished pulmonary ventilation, and this to lessened oxidation which, with failing blood-pressure, causes the tissues of the body to be enfeebled to the point of being rendered moribund.

The correct interpretation of the situation is the recognition of the anæsthetist of the fact that, when once a level of narcosis sufficient for the purposes of the surgeon is reached, very little anæsthetic is necessary to maintain that equilibrium once it is established, and that, so long as the tissues are not overnarcotized, the cells will part with the anæsthetic and regain their normal physiological status when the administration of the drug is withdrawn.

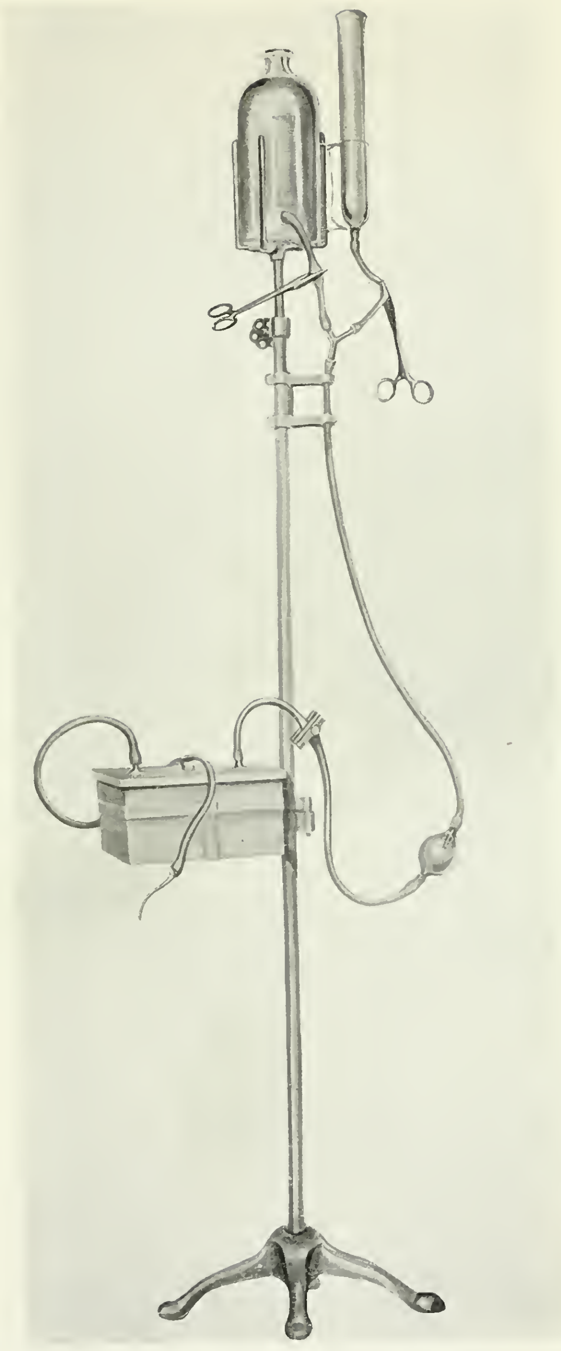
In the employment of intravenous anæsthesia, the agent is directly introduced into the blood, a minimum amount is used, it is maintained there at a certain definite percentage, and its employment can be withdrawn abruptly without storing up in the body reservoirs such excess as may subsequently prove harmful to the patient. In this method the production of anæsthesia is very rapid, the preliminary state of excitement is nearly always absent, the patient breathes almost naturally, the color of the skin remains good, and the relaxation and flexibility of muscles are absolutely satisfactory to the operator. The degree of narcosis can be maintained to a nicety and at the completion of the operation the patient often answers questions rationally before leaving the operating room, and returns to bed with better physical signs than before the anæsthetic was administered.

For the safe and satisfactory induction of anæsthesia by the intravenous route it is highly essential that the details of the technic, which is remarkably simple, be carefully and systematically observed. It is very remarkable that trained anæsthetists have failed utterly with this method in the first attempts because they neglected to familiarize themselves with a few important principles which are absolutely necessary if this method is to be successfully employed. Failures to obtain a satisfactory degree of narcosis, unfortunate complications and even fatalities have occurred which, in our judgment, are utterly unwarranted. In a very active surgical service at the Metropolitan Hospital, Department of Public Charities, Blackwell's Island, the *bete noir* of the surgeon has always been the anæsthesia. The patients for the most part are from the poorest quarters of the city, reduced by privation, hard work, poor hygienic conditions, alcoholism and pre-existing disease. They are frequently extra hazardous risks viewed from either an anæsthetic or surgical stand-point; but such has been our experience with intravenous anæsthesia that, in that institution, it is the safest, most efficient, freer from post-operative complications than any form of narcosis ever employed in the history of the Hospital. Our work has embraced about all of the operations usually performed in a large general surgical service, males, females and children and, at the present time, we can recall only one death in about 350 administrations that could be justly attributed to the method of anæsthesia and in that single instance the regrettable fatality was due to the unfortunate misunderstanding of a verbal order as to anodynes after the operation. Our first experience was with the simple infusion apparatus as recommended by Burckhardt, the originator of the method, but subsequently we used the more elaborate and satisfactory technic of Rood.

For the intravenous use of ether, the patient, having been prepared for operation, is taken to the anæsthetizing room about thirty minutes before the time for operation and placed preferably upon the operating table which is to be used during the operation. A subcutaneous injection of morphine sulphate, gr. 1/6, atropine sulphate, gr. 1/100 and scopolamine, gr. 1/100, is given at one dose, preferably in the loose tissues of the chest, abdomen or thigh. From this time until the actual anæsthesia is accomplished, it is extremely advisable to keep the patient as quiet as possible so that, when the administration begins, the patient is in a condition of reposeful relaxation of mind and body. No matter how anxious or fearful of the result of the operation, the patient in thirty minutes is sustained and supported by the hypodermic medication and the injurious effects of acute fear, which Crile has demonstrated are identical with those of acute shock, are successfully combatted. A five to seven and one-half solution of ether with filtered sterile Ringer's solution (normal saline solution may be used if the other is not available), at a temperature of 85° F. is poured into a reservoir which has a capacity of 2000 c.c. The solution is thoroughly mixed and care should be taken to see that the ether is thoroughly dissolved, for even after violent succussion there may be some stratification, the lighter ether floating upon the surface of the solution. At that temperature ether is soluble in about 10 parts of normal saline solution. It is important to note that the introduction of a large amount of solution at a temperature so much lower than that of the body produces no harmful effects, either immediate or remote. It is noteworthy to add that ether boils at 96° F. and even before that point is reached, it will have vaporized and escaped, thus offering an explanation of the failure to produce anæsthesia when ether was added to a normal saline solution, the temperature of which was at or near 96° F. with a mistaken idea that it would better conserve the vital forces of the patient.

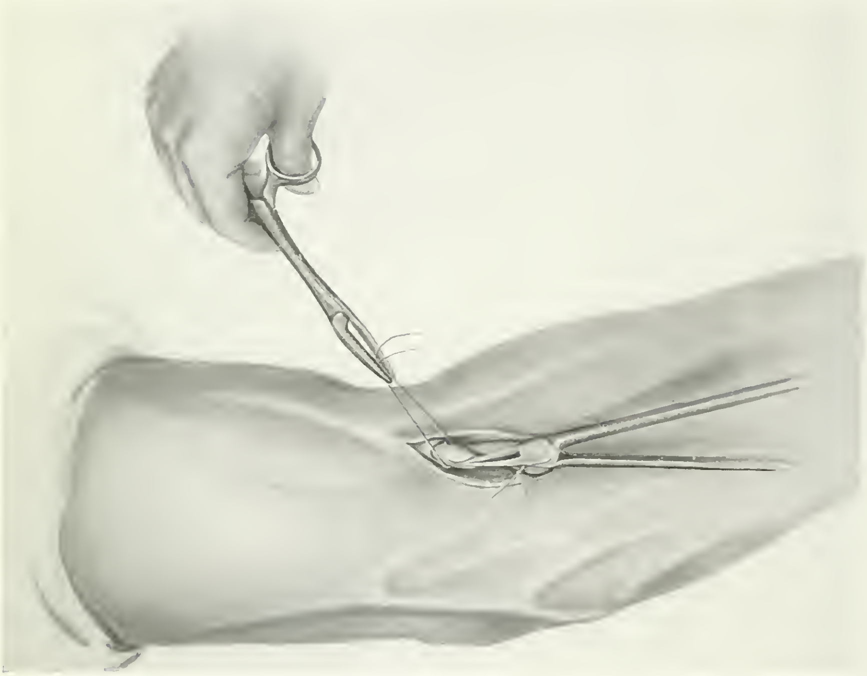
The solution having been prepared, the reservoir is adjusted on a stand eight feet above the floor level, at which point it remains during the administration. The fluid flows through an indicator (which contains a pipette) then through a rubber tubing into a blunt cannula and so into the vein. The indicator consists of a cylindrical or globular bulb of a capacity of from two to four ounces with an inside pipette very similar to that used in the Murphy apparatus for protoclysis. When the apparatus is working properly, the lower half of the indicator is filled with solution while the upper half contains air. The solution flows from the tank through the pipette and drops on the surface of the fluid in the lower half of the indicator. By means of a compression top, placed below the indicator, the rate of flow can be accurately controlled and, if the fluid in the bulb is kept at a proper level, a satisfactory index is furnished as to the rate the solution enters the vein (Fig. 1). Usually the arm furthest from the operator is selected and the median basilic or cephalic vein exposed, but should the operative field be the skull, face, neck, or chest, where the infusion apparatus would inconvenience the surgeon or his assistant, the internal saphenous at the internal malleolus is selected. As a matter of fact, any vein, in any locality remote from the operator, may be utilized, the simple precaution being that it is superficial, free from varicosities, and sufficiently large to be readily exposed and to admit the small cannula through which the anæsthetic solution is to be introduced into the system. If the elbow is selected, a padded splint, large at one end and tapering to a size somewhat wider than the forearm is placed beneath the

Fig. 1.



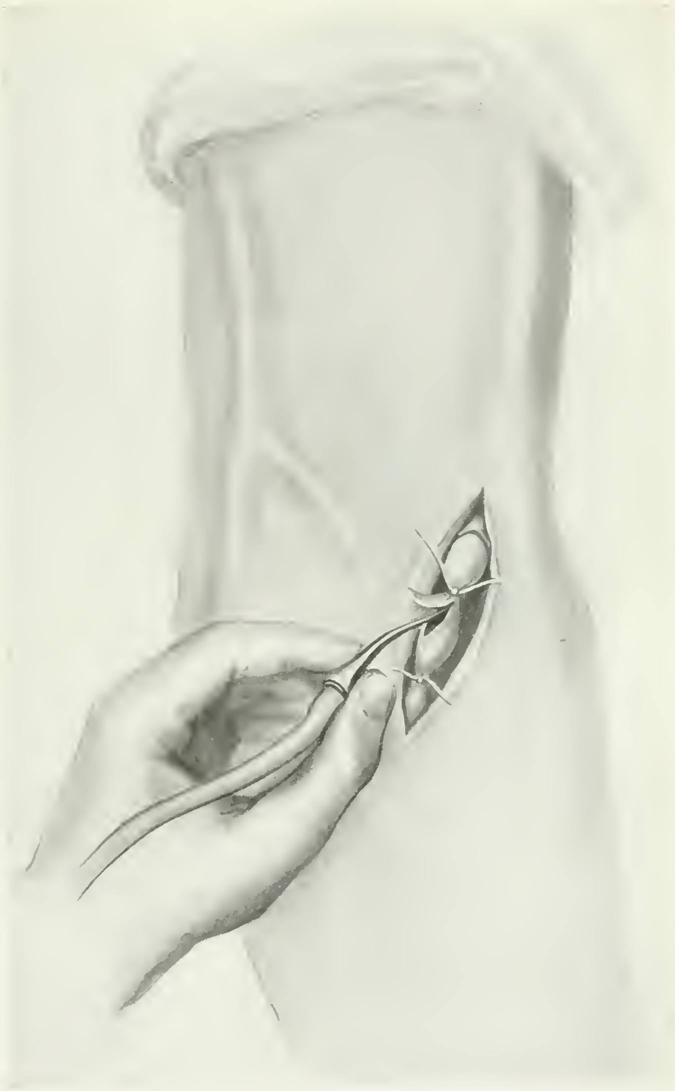
An apparatus designed for use in any form of intravenous anæsthesia. The narrow tube by the side of the reservoir is for the introduction of a solution of hedonal or isopral preliminary to the employment of a solution of ether.

FIG. 2.



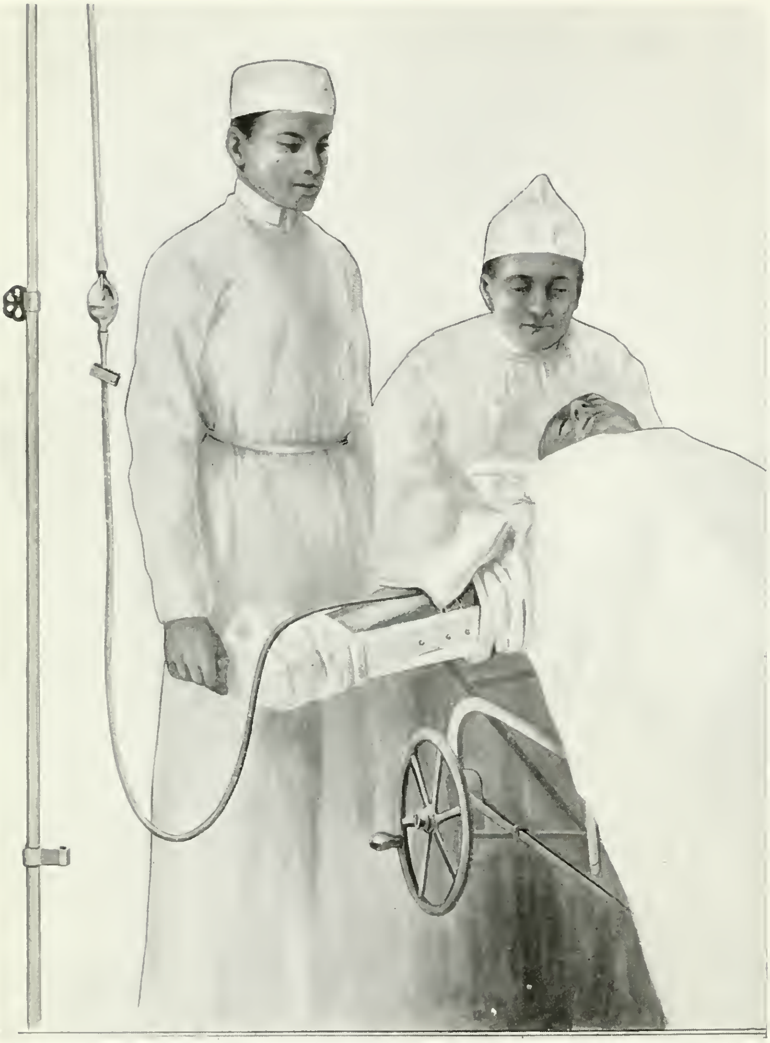
Vein has been exposed and ligated distally, this ligature not shown in illustration. Vein is being opened with scissors.

Fig. 3.



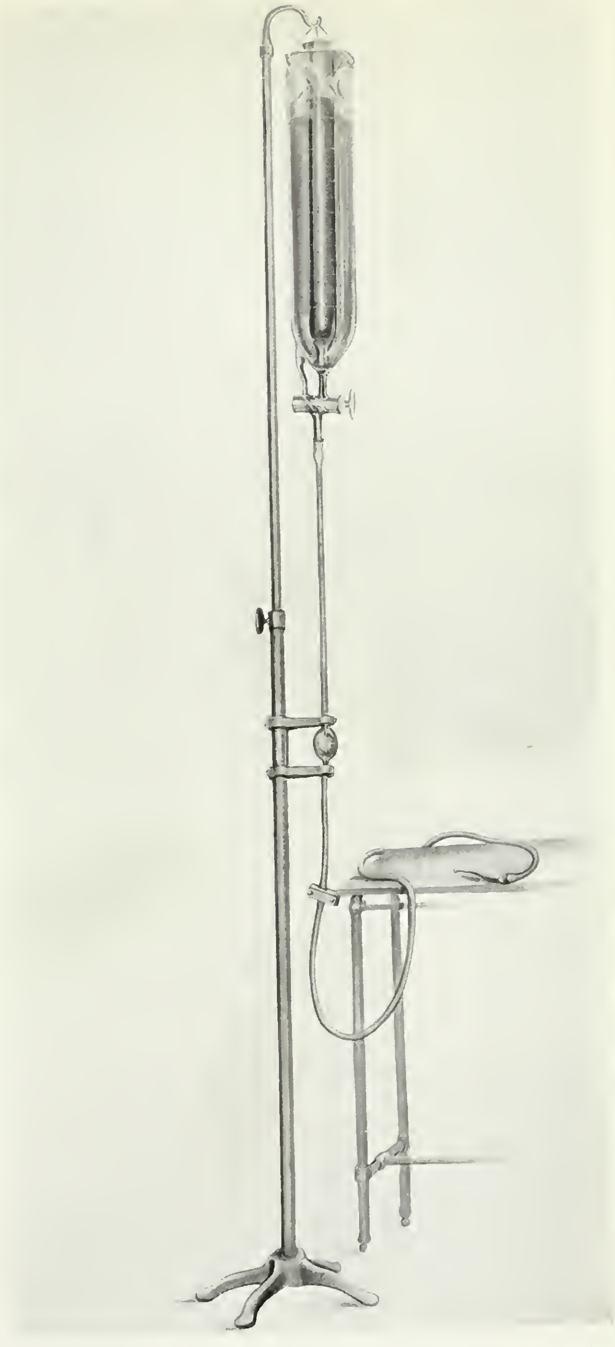
Cannula introduced and tied in the vein.

Fig. 4.



Patient under anæsthesia by intravenous method. Note globular indicator with control stopcock. Also method of maintaining arm in proper position.

Fig. 5.



Another model apparatus for intravenous anæsthesia in which the reservoir and tube for preliminary narcosis is in one piece, and the solutions controlled by an ingeniously perforated glass stopcock.

patient, extending from beyond the tips of the fingers to the opposite side of the body; a few turns of a three-inch bandage just above the wrist will maintain extension of the forearm and prevent involuntary movements which might occur in the first stage of anæsthesia and dislodge the cannula from the vein, an embarrassing but easily preventable accident. A space of about four to six inches over the bend of the elbow is now firmly wiped once over with a 5 per cent. solution of thymol in carbon tetrachloride, on a piece of gauze. This is sufficient to thoroughly sterilize the skin, which has not received any previous preparation. It has an advantage over iodine, usually employed, in that it is more efficacious and, as an antiseptic, does not discolor the skin, the latter a great advantage when superficial veins are to be dissected. It is not advisable to bandage the distal extremity of a limb to render the veins more prominent as the compressor must be very quickly removed when the cannula is introduced and that often adds to the difficulty. If the veins are not particularly prominent, an assistant may make some pressure with the hand on the upper and inner aspect of the arm while the vein is being exposed. There should be no blundering at this point, since nothing so disturbs the *morale* of the patient, destroys confidence and adds fear and anxiety, when composure should be supreme, as the futile, clumsy attempts to find the vein by anæsthetists not accustomed to doing surgical work.

We make it very emphatic that the exposure of the vein and the introduction of the cannula should be done by the operating surgeon, the anæsthetist taking charge of the apparatus and watching the respiration and cardiac action. It is important that this small but important step be done with scrupulous regard to asepsis, since septic thrombosis at this point might lead to unpleasant after results. The anæsthetist therefore relieves himself of a burden of considerable responsibility when he relegates the surgical part of this procedure to the experienced operator. The skin over the vein selected is infiltrated with a few drops of one-half of one per cent. solution of cocaine, sufficient to make a bleb one-half inch in diameter. The skin containing the bleb is drawn aside from the vein with the thumb of the left hand so as not to be directly over the vein, and a small incision one-third to one-half an inch made through into subcutaneous fat. The vein is now exposed by wiping with a bit of gauze for two or three firm strokes. A small hæmostat, with a double ligature of No. 1 catgut, is now carefully thrust beneath the vein and, by gently moving it horizontally in and out, the vessel is lifted from its bed and the exposure is complete. The ligature is cut, the lower half is tied tightly and attached to a hæmostat, the upper half being tied loosely with half a knot and also clamped with a hæmostat. The operator now takes the proximal ligature in his left hand, the assistant making slight tension on the one distal; the vein is lifted and put somewhat on the stretch. With a small rather blunt scissors an incision is made embracing about two-thirds the calibre of the vessel (Fig. 2). The operator now takes the cannula in his right hand and, slightly relaxing tension on the proximal ligature which he holds, he is able usually to quickly insinuate it into the cavity of the vein. By manipulating the proximal ligature as to tension, he is able to facilitate this movement, though it is often advisable to have the assistant pick up the flap of the incised vein with a small pair of anatomical forceps which exposes the lumen, steadies the vessel and very considerably facilitates the introduction of the cannula. The half loose knot in the proximal ligature is now drawn snugly down on the cannula, which is sufficient to hold it in place (Fig. 3). A piece of adhesive plaster about 3 inches wide is placed about the rubber tubing connected with the cannula, which relieves all tension and tends more than anything else to prevent the accidental slipping of the tube from the vein. A large gauze pack is now placed over the incision and the surgeon and assistant take their respective places to begin the contemplated operation (Fig. 4). We have found that actual exposure of the vein and tying on of the cannula is the most satisfactory and safe procedure, many suggestions having been made as to the use of a technic similar to that employed in the salvarsan treatment, special needles have been made and tried only to return to the very satisfactory procedure described above.

The solution should be administered at a full flow at the beginning, the anæsthetist reducing the stream at the appearance of the usual signs of surgical anæsthesia. It is quite as incumbent upon the anæsthetist to take the usual precautions to secure and maintain an unobstructed air-way and efficient respiratory act, as in the usual method of anæsthesia. Ether is rapidly eliminated by the lungs in this method, and, as is true of all methods, efficient respiration prevents accumulation and tension on the tissues, increases its output, and lessens its toxicity. In from one to five minutes anæsthesia will be complete and the operation may proceed.

It is highly important, as was noted above, to be economical in the use of the anæsthetic solution; the patient should be placed in the appropriate position for the intended operation, the operative field draped, the skin disinfection completed, and the surgeon absolutely ready to make the initial incision when the cannula is inserted into the vein. There is a limit to the patient's tolerance for even salt solution, and it is very desirable that any portion of the period of anæsthesia be not wasted upon preparation but reserved solely for the actual operative technic. When the degree of narcosis is obtained, which varies somewhat with the nature of the operation, the flow into the vein is reduced by the control-cock just below the indicator. It may be allowed to drip in a very fine stream or at the rate of 40 to 60 drops per minute, the corneal reflex affording a reliable guide for administration. The anæsthetist readily becomes acquainted with the effects of the drug by this method, and as narcosis can be absolutely and beautifully controlled, there is no need for any embarrassment to the operator from involuntary muscular contractions. Again let it be urged that careful attention be directed to the maintenance of an open air-way, and as the muscles of the jaws and neck are very much relaxed, the tongue should not be allowed to drop back into the pharynx. It is more important to attend to these respiration precautions than if the patient were being anæsthetized by the inhalation method. Latterly we have found the use of the Hewitt breathing tube very useful in assisting to maintain proper air-way and also as an aid to holding the tongue forward. Our usual practice is to fix the tongue with a pair of fine tenaculum forceps and let them hang by their own weight. We advocate a continuous flow in intravenous anæsthesia, no matter what agent is employed as the hypnotic, though a few times we have interrupted the stream for a few moments without any appreciable harmful effect at the conclusion of the operation unless it has been quite prolonged; particularly if ether alone has been used, the dressings should be applied before the flow is actually stopped, as the return to consciousness often comes very promptly and the patient may resist efforts to finish the toilet of the incision properly. The blood-pressure rises slightly with the use of ether in this way—we use it preferably in the old and cachectic patients, avoiding its use in young, full-blooded, or alcoholic subjects.

Oozing is more noticeable, perhaps, in the operative field, and, if the cavity of the abdomen is the seat of the operation, fluid rapidly accumulates there. If extensive adhesions are to be dealt with, the fluid rapidly becomes blood-stained, and there might be instances where this might embarrass and delay the operator, but we have not been so troubled. The patient may be brought from one degree of anæsthesia to another very rapidly by the judicious use of the control indicator, and it is well that the operation be entirely finished and dressings applied before the administration is stopped, as the patient returns to consciousness very quickly. If the administration has been skilfully performed, the patient will quietly drop to sleep without any appreciable indication of a stage of excitement. The face will flush, eyes roll and some of the voluntary muscles stiffen for perhaps a few seconds, when suddenly the patient seems to have fallen into a quiet but deep sleep without the noisy stertorous respiration usually associated with narcosis. The usual signs, corneal reflex, pupillary indication, etc., are about as noted in the same degree of anæsthesia by the inhalation method. At the conclusion of the operation, which may last from two to three hours, at the expenditure of about 1000 c.c. of solution per hour, the cannula is withdrawn by a quick jerk from the vein, the loose half knot of catgut is tied which ligates the proximal portion of the vein. The wound is closed with a few fine silk sutures of 000 silk on No. 10 straight needles, wiped once with carbon tetrachloride and thymol, 50 per cent. solution and an aseptic dressing applied. The patient is returned to bed and, if much solution has been used and the operation prolonged, a semi-Fowler position is employed and the nurse instructed to turn the patient every one or two hours. This is a necessary precaution for, if a very great quantity of fluid is used, there are naturally some possibilities of pulmonary œdema and, curiously enough, certain spots on the back and buttocks often develop, looking like bruises. This is due to the anæsthetic fluid settling in the loose fatty tissue of the most dependent portion of the body. Occasionally the patient will have a chill such as occurs when saline infusion is given to combat shock. This condition quickly subsides, particularly if hot water bags are placed about patient. It is a curious fact that this phenomenon will occur when solutions ten degrees higher than the bodily temperature are introduced into the circulation. The employment of ether in this way seems almost devoid of danger from either immediate or remote complications and represents the basic type of intravenous anæsthesia, from which have grown many modifications.

We have experimented with a considerable number of drugs, either alone or in combination in the same solution with ether. The combination of drugs having distinct hypnotic properties, in the same solution with ether, seems to produce a very smooth, even and satisfactory narcosis, which could be maintained with a smaller amount of fluid than when ether alone was used. Paraldehyde and ether gave splendid results, deep anæsthesia being produced almost as quickly as with hedonal, but we have practically discontinued its use for the reason that, as it is very rapidly eliminated from the lungs, the vapor seems to produce a decided irritation of the larynx on certain individuals, particularly to those addicted to alcohol, and a crowing, croupy, spasmodic respiration due to spasm often supervenes at about the close of a moderately long operation. This condition would not banish it from our armamentarium were it not for the fact that the employment of mixtures containing paraldehyde were the ones that produced blood changes worthy of note. Hedonal 0.75 per cent. and ether 5 per cent. makes an admirable combination but such satisfactory results, with a different drug and slightly altered technic, were obtained, that it may be said to be the last word on the subject. Attached to the side of the reservoir usually employed, there is a secondary salvarsan tube of about 350 c.c. capacity. Rubber tubing from the two glass receptacles are attached to the divergent arms of a glass Y and the tube, which is connected with the indicator and cannula, is attached to the remaining free arm. A hæmostat is clamped upon the tubes leading from both vessels. Into the smaller is poured 250 c.c. of a one and one-half per cent. of isopral in Ringer's solution, and into the other 2000 c.c. of a 5 per cent. solution of ether. The vein being exposed and opened, the hæmostat is removed from the tubing leading from the smaller vessel containing the isopral solution, the cannula is inserted into the vein and fluid is allowed to flow very slowly so that it will take between four or five minutes for that quantity to enter the circulation, according to the tolerance of the patient; complete anæsthesia is induced with a greater or less amount of the solution but almost invariably it is accomplished with the entire amount, the condition and resistance of the patient notwithstanding. Before the entire quantity has entered the vein, the hæmostat again is clamped on the branch tubing and that from the one leading from ether solution simultaneously removed, so that complete anæsthesia being induced, it is continued with ether. This same technic can be applied to hedonal in the same way, only using a 0.75 per cent. solution. Intravenous anæsthesia induced in this way is very satisfactory, safe and reliable; the drugs used in the way described seem to have almost a synergistic physiological action in producing narcosis. The important part of the procedure is to give hypnotic solution very slowly until anæsthesia is induced, immediately this is accomplished, stop its administration and advance the ether mixture. The narcosis is probably better and certainly more safely produced in this manner, and may be continued and maintained with the expenditure of less fluid than by any of the other methods referred to and it may be said that, at the present state of development, it is easily the method of choice.

Blood Changes.—In every case it was found that ether raised the blood-pressure from 2 to 24 mm., this rise being followed by a fall of 2 to 20 mm. in from one to three hours and then gradually returned approximately to the point observed before operation.

Hedonal invariably lowered the blood-pressure from 6 to 25 mm. of mercury, paraldehyde in about the same proportion, so also isopral. When mixtures were used, such as hedonal and ether, paraldehyde, or isopral and ether, the blood-pressure was influenced to the extent of being about the same as before the operation, as only a small quantity of the hypnotics was used in the anæsthetic mixtures. They, however, in every instance prevented the increased pressure noted when ether-scopolamine-morphine combination was used. It was singularly noted that female patients showed little or no change in the blood pictures, neither did males in operations of short duration. Alcoholic habitues naturally required more anæsthetic and, in one case, in which anæsthesia was accomplished with a 5 per cent. solution of paraldehyde in normal saline, there was decided crenation of red cells with some clumping crenation, and some crenation was noted when a mixture of ether 3 per cent. and paraldehyde 2½ per cent. was employed. Some crenation was also noticed in one case where a large quantity (3500 c.c.) of 7 per cent. ether in normal saline was used. In every case the blood picture returned to normal in about four hours.

Hæmoglobin, estimated by Tallquist scale, showed an average diminution of 5 per cent. There seemed to be no changes either in appearance or number of the leucocytes, and where an actual leucocytosis was observed before the infusion was given, the blood picture was practically unchanged. The erythrocytes were not materially affected except in three cases in which narcosis had been produced by paraldehyde.

Urinary Examination.—The urinary analysis made before the operation and for three or four days afterward showed no marked differences in the specimens. The total amount was increased and specific gravity lowered during the first twenty-four hours; often the specific gravity and solid content of the urine remained unchanged. In no case, even after employing 7½ per cent. ether solution, did blood, albumen or casts appear in the urine, though German observers did report occasional cases of transient hæmoglobinuria after the use of the stronger ether mixtures. It was quite surprising that there was not a large urinary output after the infusion of large quantities of fluid, so much so that the patients were regularly catheterized, thinking perhaps there might be some vesical paresis from over-distention, but we failed to find at any time a urinary output in proportion to the amount of fluid introduced into the circulation.

NITROUS OXIDE AND OXYGEN NARCOSIS.*

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THE object of this paper is a plea for a better selection of cases and more accuracy in administration in the use of nitrous oxide and oxygen for prolonged anæsthesia.

Most anæsthetists agree that aside from its well-known contra-indications, nitrous oxide and oxygen does not meet the requirements of every case of anæsthesia. Also many cases that apparently respond to the effects of this agent most beautifully are subject to greater risk than those that do not.

In most cases in which nitrous oxide and oxygen is used, as we approach the use of 15 per cent. oxygen with the nitrous oxide, we find that we fail to get complete anæsthesia; and as this is below the normal oxygen supply, nitrous oxide and oxygen anæsthesia is complicated with oxygen limitation. And since the principal problem to be solved in nitrous oxide and oxygen anæsthesia is the oxygen supply, any condition which to any extent hampers the oxygen reaching the ultimate tissues of the body is a contra-indication for its use. This may be, first, a mechanical obstruction to the respiratory passageways, second, inadequate lung capacity in proportion to the body weight, third, anæmia, or, fourth, toxic conditions in which the hæmoglobin has to an extent combined with certain toxines, which limit the extent of its combination with oxygen.

Mechanical obstructions of the respiratory passageway as contra-indications for the administration of nitrous oxide and oxygen are well known.

A condition which we cannot regard as strictly abnormal but which is a contra-indication for nitrous oxide and oxygen, is that condition usually found in muscular and plethoric people and sometimes in others in which the lung capacity is small in proportion to the weight of the individual. Diseased conditions in which lung tissue has been destroyed or in which the excursions of the lungs are diminished by empyema, adhesions, or by pressure on the diaphragm, are the same in effect as regards nitrous oxide and oxygen. In these cases the lungs and the hæmoglobin are called upon to functionate more actively in order to furnish the necessary amount of oxygen, usually resulting in an inefficient respiratory exchange and, because of this, these individuals will stand less limitation of oxygen, and nitrous oxide and oxygen should be used with caution or not at all.

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* Read before the American Association of Anæsthetists, June 18, 1913.

Although anæmic individuals respond quickly and easily to nitrous oxide and oxygen, its use is contra-indicated. In these cases the passageway may be unobstructed, the lung capacity sufficient and the body weight not excessive, but the hæmoglobin is deficient to the extent that the oxygen supply to the tissues is impaired.

A similar condition in regard to nitrous oxide and oxygen is severe toxæmia. In these cases the amount of hæmoglobin may not be deficient, but a portion of it may be combined with toxines leaving a deficient amount of serviceable hæmoglobin, thus limiting the normal supply of oxygen to the tissues. The hurried respiration of toxæmic patients is an effort on the part of nature to get oxygen to the ultimate tissues and indicates, as does also the cyanosis, that a portion of the hæmoglobin has united with toxic substances.

If conditions are such that nitrous oxide and oxygen is the only anæsthetic that can be used in cases of toxæmia (and the same may be true of anæmia), the oxygen supply may be raised much higher than in other cases and the narcosis maintained may be very light, because a patient in a high degree of toxæmia enjoys a certain degree of analgesia, as we see exemplified by patients in toxic conditions declaring that they " feel better " as death approaches, which of course is coincident with less hæmoglobin being available for oxygen combination.

Now bordering upon these cases in which nitrous oxide and oxygen should not be used, is a large class of individuals with whom the success of nitrous oxide and oxygen is wholly dependent upon the proper percentage of oxygen. Because of the preceding contra-indications existing to a greater or less extent and in various combinations, we may lay down a rule of more or less accuracy regarding the percentage of oxygen to be used with the nitrous oxide in some such manner as follows: The percentage of oxygen required with the nitrous oxide is to the respiratory exchange as the weight of the body is to the lung capacity.

Experience has taught us that a patient that is anæmic to the extent of 50 per cent. hæmoglobin, requires 20 per cent., or nearly 20 per cent., of oxygen with the nitrous oxide and since a normal individual can get along nicely with 10 per cent. oxygen or even less, it would seem that 50 per cent. of anæmia reduces the hæmoglobin oxygen carrying capacity about one-half. But the respiratory exchange when deficient from anæmia does not effect the required oxygen supply with nitrous oxide in arithmetical progression. If the anæmia is less marked, still greater limitation of oxygen in proportion may be used. As an example: An individual of normal build and hæmoglobin of 60 would require only 12 to 14 per cent. oxygen instead of 14 to 16 per cent. as we would expect from the above. This is probably because a hæmoglobin percentage of less than 100 provides for normal respiratory exchange with most individuals, and also because a very low percentage of hæmoglobin (15 or 20 per cent.) would cause cessation of functionation and be the same in effect as zero or no hæmoglobin at all.

An example in regard to toxæmia: Suppose a patient is toxic to the extent that the respiration is increased to 35 to 40 per minute in order to maintain an efficient respiratory exchange which would give about double the normal air supply, then it would be logical to administer 20 per cent. of oxygen with the nitrous oxide, and practically this seems to work out about right.

As an example in regard to lung capacity: Suppose an individual developed normally to maturity and weighed 150 lbs. Then after a few years his weight increased to 180 lbs. or one-fifth more. Instead of a 2 per cent. increase of oxygen this patient should have a 3 or 4 per cent. increase. A reason for this may be that the requirements for oxygen are somewhat greater in proportion than the increase of weight because a relative delinquency exists not only of the lungs but of the heart and other organs as well. The later in life the patient has taken on the additional weight, the more evident will be the inadequacy of pulmonary functionation.

As a child develops its lung capacity becomes greater in proportion to its body weight. Therefore the younger the child the less efficient is the respiratory exchange, and other things being equal, the greater is the contra-indication for nitrous oxide and oxygen, and if nitrous oxide and oxygen is used, the greater should be the oxygen percentage with the nitrous oxide; thus a child of four or five will require nearly or fully 20 per cent. of oxygen with the nitrous oxide and it may run as high as 25 to 30 per cent., or even higher, in prolonged anæsthesia. Therefore, because of this disproportionment between lung capacity and body weight in children, it is not advisable to use nitrous oxide and oxygen for prolonged anæsthesia, and if used as a preliminary to ether, it should be only to the point of moderate or light narcosis and of short duration.

The reason, although seldom analyzed, that chloroform is a popular anæsthesia for children in spite of the fact that chloroform is more dangerous for children than adults, is principally due to the fact that they cry less when the administration is begun. Most of the crying can be prevented by beginning with a little nitrous oxide, not enough to produce any cyanosis or complete anæsthesia, and following it immediately with ether. This is done by using the foot pump connected to the nitrous oxide-oxygen-ether apparatus and to a perforated rim mask by means of a rubber tube, holding a towel around and over the mask while the nitrous oxide is given. If the surgery is for tonsils or adenoids, it is easy to change the rubber tube from the mask to the mouth gag after etherization.

Nitrous oxide and oxygen should not in any case be used as a preliminary to ether, if any of the contra-indications exist which would make the use of nitrous oxide and oxygen inadvisable for use for prolonged anæsthesia.

It sometimes happens in the administration of nitrous oxide and oxygen that the patient, especially if he has not become frightened, will enjoy analgesia without anæsthesia and will completely relax and permit extensive operations in this condition. Or patients may merge from a state of anæsthesia to that of analgesia without any struggling or rigidity, at times during an operation if the administration is uneven or if there is an air leakage. At these times the patient has control of the rate and depth of the respiration and may either for amusement or for the purpose of attracting attention or self-adulation, purposely " hold their breath " or breathe very fast, so for this reason I believe that advice to the patient in regard to the breathing before beginning the anæsthesia, is of value. There can be no doubt that Hewitt's advice of a breath of air every three to five minutes with the nitrous oxide and oxygen, is of very great importance in preventing respiratory difficulties. I believe it is seldom if ever necessary to give nitrous oxide to the extent that secondary dilatation of the pupil occurs any more than it is necessary to push ether until the patient goes into the fourth stage.

The cyanosis resulting from the administration of nitrous oxide with deficient oxygen is due to a lack of opportunity for the blood to absorb the required amount of oxygen and not to an abnormal condition of the circulatory or nervous system. It disappears quickly when air or oxygen is added and although this condition should not be permitted to occur, it is probably no more dangerous than the cyanosis that accompanies a paroxysm of pertussis. But we may encounter another type of cyanosis which is entirely different in character,—it usually comes on slowly, is preceded by a marked interval of ashy pallor, is not accompanied by rigidity, disappears slowly even though pure oxygen is given, and is indicative of a loss of vasomotor tonicity or impaired heart action and is often followed by cessation of the respiration. I have seen this condition two or three times in very anæmic individuals, and while none of them died it certainly was most alarming.

Rebreathing is a means of considerable economy in prolonged nitrous oxide and oxygen anæsthesia. It is also of decided value for its stimulating effect on the respiration if at any time it becomes slow or shallow. But the amount of rebreathing used should vary but little, that is, it should be more or less constant. It is inadvisable to change suddenly from fresh gases to a large amount of rebreathing or *vice versa,* because it produces a sudden change of tension of both carbon dioxide and oxygen in the blood.

The apparatus I use is so constructed that rebreathing may be entirely avoided or used constantly to any extent desired. Rebreathing is accomplished by means of a rebreathing bag made of dipped rubber about the weight of a medium-weight surgeon's glove and holds about 1000 c.c.—the most that a patient is likely to respire. It is attached to the face piece, and the inspiratory rubber valve which is between the rebreathing bag and the inhaling tube, makes it impossible for the exhalation to pass back into the inhaling tube, apparatus or gas bag, which could not be sterilized if contaminated by the patient's respiration. The entire face piece together with the rebreathing bag, may be thrown into boiling water and sterilized without injury. The face piece is provided with two thin pliable rubber valves which offer no appreciable resistance even when wet because of their ability to loosen themselves from their seat at various points of contact instead of the necessity of every point of contact being loosened at the same time as is the case of solid valves.

The inspiratory rubber valve should be of thin dental rubber dam which will respond very easily to the inhalation. The expiratory (outside) rubber valve should be considerably heavier and offer more resistance. This will cause a constant reserve in the rebreathing bag while it is being used, which will permit all the inhalation being a homogeneous mixture with rebreathed air. Otherwise the rebreathing bag will become empty the latter portion of each inhalation, causing a change during each inhalation from rebreathed gases in the rebreathing bag to fresh gases from the apparatus, alternating the composition and temperature of the inhalation suddenly during each respiration.

When the slot of the rebreathing bag is open full, the patient will rebreath completely and it is easy to estimate with fair accuracy the depth of respiration and to adjust the rebreathing slot to use one-fourth, one-half or three-fourths or any portion of rebreathing desired. A constant amount of rebreathing employed, permits the use of a small rebreathing bag which is cheaply replaced when necessary.

One-fourth rebreathing does not call for any appreciable increase in the oxygen percentage; with approximately one-half rebreathing one or two per cent. more oxygen should be added; and when the patient is rebreathing approximately three-fourths, from three to five additional per cent. of oxygen should be added.

As a preliminary to ether I believe nitrous oxide and oxygen has no equal. Since by mixing oxygen in the proper proportions with nitrous oxide, complete narcosis can be maintained indefinitely, it may be used sufficiently long (three to five minutes, occasionally longer) to permit the ether to be administered gradually and slowly until complete ether narcosis is established. As the nitrous oxide and oxygen is continued until complete ether narcosis is established, there is then no return of the reflexes when air is substituted and consequently no swallowing of ether-laden secretions. The swallowing of ether-laden secretions is in all probability responsible for most of the early nausea and vomiting following ether narcosis. If nitrous oxide is used alone without oxygen preliminary to ether, the nitrous oxide administration must be of short duration because of the asphyxiation which would otherwise follow.

This makes it necessary to overwhelm the patient with ether and even then, the patient will almost invariably come out between the gas and ether narcosis to the extent that swallowing will occur about as much as if gas had not been given and the nausea and vomiting follow in about the usual percentage of cases.

The variation of oxygen percentages which may be used successfully with nitrous oxide and oxygen in prolonged anæsthesia is usually about three per cent. Less than this the patient becomes cyanosed and with more than this, partially "comes out." Therefore, to obtain the best results, it is a decided advantage and, unless the anæsthetist is skilful, it is necessary that the apparatus provide means for accurately measuring the oxygen dosage. Also with patients of unusual type or in unusual conditions, the judgment of the anæsthetist in using certain known percentages of oxygen with the nitrous oxide according to the individual case, is of great value as explained heretofore.

The passage of the inhalation through the passageways and the several feet of inhaling tube of any apparatus warms the inhalation to a point close to that of the room temperature. Gases when passed through tubes, become the same temperature of the tubes surprisingly quick. In regard to the heating of the gases up to or above body temperature, it would be well to remark that by the time the gases have reached the alveoli of the lungs, they have become practically body temperature irrespective of their original temperature. It is an easy matter to overheat an inhalation. We are well aware of the inefficiency of air and the difficulty of satisfactory respiration when the thermometer is close to or above body temperature, and we cannot reasonably expect it to be more efficient to a patient under anæsthesia.

A few words in regard to the mechanical side of nitrous oxide and oxygen administration for prolonged anæsthesia would not be out of place. The workmanship on the apparatus should be such that every joint and connection is absolutely air-tight, so that it will not be necessary to use a positive pressure to prevent an ingress of air. It is better and almost necessary that the valves and connections are tapered and hand ground. A positive pressure is only necessary for the use of a nasal inhaler in dental work or occasionally for tonsils or adenoids in adults or to prevent the admittance of air through the valves and connections of a leaky apparatus. A measured administration of oxygen with the nitrous oxide is of little or no value with the nasal inhaler, because the nitrous oxide is always more or less mixed with air by a portion of the inhalation coming in through the open mouth; in fact, the use of oxygen with a nasal inhaler does not seem to be necessary at all, both because of the air ingress through the mouth and because a nasal inhaler is seldom used for any other purpose than obtaining analgesia. A positive pressure absolutely prevents the use of oxygen by percentages because it is a mechanical impossibility to adjust two reducing valves to give the same pressure, but the use of partially filled bags gives the same pressure (atmospheric pressure) in both nitrous oxide and oxygen bags and permits a measured dosage of the gases. An atmospheric or slightly negative pressure anæsthesia, also uses far less nitrous oxide and oxygen than does a positive pressure and does not require a change of oxygen dosage with every variation of respiration. The nitrous oxide and oxygen bags should be large so that they will require but little attention to keep them partially filled.

Freezing of the cylinders is easily prevented by using reduced openings (one sixty-fourth or less of an inch in diameter) in long yoke nipples. They prevent a marked expansion of the gases until well into the cylinder arms where there is plenty of metal to take up sufficient heat to prevent freezing.

A mixing chamber is not only useless, but of decided detriment. The passageways and inhaling tube or even the pharynx of the patient is all that is necessary for a mixing chamber and anything more than this is merely a means of air contamination in the beginning, and later, of delaying the effects of a change of dosage in reaching the patient. Neither should there be a valve of any kind in either the nitrous oxide or oxygen passageways back of the mixing valve, because such a valve interferes with the percentages used and is unnecessary when the rebreathing bag is attached to the face piece.

A bore of at least one inch in diameter for the tube and passageways is necessary to prevent the patient from complaining of the negative pressure. Nothing frightens a patient more than when the mask or inhaler is placed over his face to find that it is difficult for him to get a full and free inhalation.

Not every physician, no matter how complete his knowledge may be of the art and science of anæsthesia, can become adept in the use of nitrous oxide and oxygen. A man to use nitrous oxide and oxygen successfully, must be a man that not only possesses the required knowledge, but must possess it sufficiently well that it becomes almost reflex with him. He must not be a phlegmatic sort of an individual, but quick and alert. The untoward symptoms of nitrous oxide and oxygen are so variable and change with such rapidity that he must be able to almost anticipate any one of them before it occurs.

The extent and distribution of the use of nitrous oxide and oxygen for surgical anæsthesia is practically the same as the numbers and distribution of skilled anæsthetists. Those anæsthetists who have no disposition to acquire the skill and technical knowledge necessary for the proper selection of cases and the successful prolonged administration of nitrous oxide and oxygen, are, for the most part, not favorably inclined toward its use. This is perhaps fortunate both from a humanitarian stand-point and because its use by them would soon discredit this highly valuable anæsthetic agent.

In conclusion I wish to say that if I have succeeded in adding another protest against the indiscriminate use of nitrous oxide and oxygen and against the disposition on the part of many anæsthetists to ignore some of the more important refinements of nitrous oxide and oxygen narcosis, I will feel I have accomplished something.

INTRATRACHEAL ANÆSTHESIA.*

A. BY NITROUS OXIDE AND OXYGEN.

B. BY NITROUS OXIDE AND OXYGEN UNDER CONDITIONS OF DIFFERENTIAL PRESSURE.

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A. The introduction of intratracheal anæsthetization by ether immediately suggested the desirability of using nitrous oxide and oxygen by the same method.

Much evidence exists that surgery may be made more successful by the more general use of nitrous oxide anæsthesia. Both nitrous oxide and intratracheal anæsthesia have acknowledged advantages, and it becomes, therefore, a matter of importance to combine the good features of each.

Cotton, Boothby, Gwathmey and others have successfully kept patients under surgical anæsthesia by nitrous oxide, after a preliminary etherization, by simply allowing the mixed nitrous oxide and oxygen to stream in through the intratracheal catheter in the same manner that ether vapor is given intratracheally.

Such a method is wasteful of the anæsthetic, which under these conditions must be supplied in such excess that, at each inspiration by the patient, there is a very little dilution of the anæsthetic within the trachea by air which, otherwise, would be drawn through the larynx around the intratracheal catheter. There must, in other words, be such a supply of nitrous oxide, that only a minimum amount of air is drawn in around the intratracheal catheter during inspiration. To supply such an excess of anæsthetic is not perhaps objectionable when ether is used, as ether is cheap in comparison to nitrous oxide, and further it is a comparatively easy matter to secure a sufficient degree of concentration of ether vapor to anæsthetize satisfactorily a patient by the usual intratracheal technic. Moreover, the escape of the air around the tube during the intratracheal anæsthesia by ether has been encouraged for the purpose of preventing the inhalation of blood and mucus during intra-oral operations.

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* Read before the American Association of Anæsthetists, June 18, 1913.

Nevertheless, during ether anæsthesia the escape of large quantities of ether in the room is at least unpleasant, even if the waste of the ether is not considered a matter of importance.

In order to overcome these difficulties, in connection with anæsthesia by nitrous oxide, the writer has devised the little bag illustrated in Fig. 1. It is tubular in shape possessing a double wall so that it is capable of distention whether fitted over the catheter or not. It is pulled over the latter to a short distance above its extremity, and after the catheter is inserted into the trachea, the bag is distended with air through the fine rubber tube attached to it, thus effectually closing the space between the outside of the catheter and tracheal walls. The patient may now breathe in and out through the intratracheal catheter, and when the external end of the latter is attached to a respiration bag, receive the nitrous oxide and oxygen directly from the tanks undiluted with air.

Fig. 2 represents the arrangement of the various parts of the apparatus used for intratracheal anæsthetization by nitrous oxide and oxygen according to this method. (4) is a reducing valve, the legs of which are detachable so that everything necessary for this method of anæsthesia can easily be carried in a small bag.

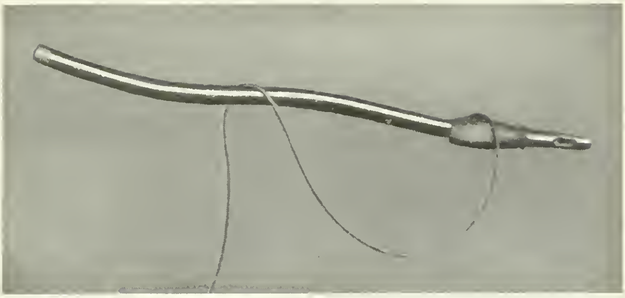
The tank is attached to the reducing valve, as illustrated, and because of the latter, a regular flow of the gas passes to the wash bottle (3) through the tube (2). Into the same bottle, upon the opposite side of a central partition the oxygen enters through the tube (8).

The purpose of the wash bottle is to furnish a visual method of estimating the flow of the gases. We are perfecting a more exact method of measuring the gases. By means of the third tube the mixed gases are conveyed to the respiratory bag (6). This bag must never be allowed to become completely filled and, in order to guard against distention, it is wise to insert a safety valve between it and the wash bottle. The respiratory bag is attached by its opposite end to a cylindrical valve. The latter is made of two cylinders, the external one of which possesses three openings upon one side (A, E, D) the intake side, and one (C) opening upon the opposite side, to which the tube passing to the intratracheal cannula (7) is attached.

The openings through the inner cylinder are so arranged that as it is rotated, one of the three openings (A, E, D) entering the cylinder upon one side, may be thrown into communication with the single opening (C) emerging upon the opposite side.

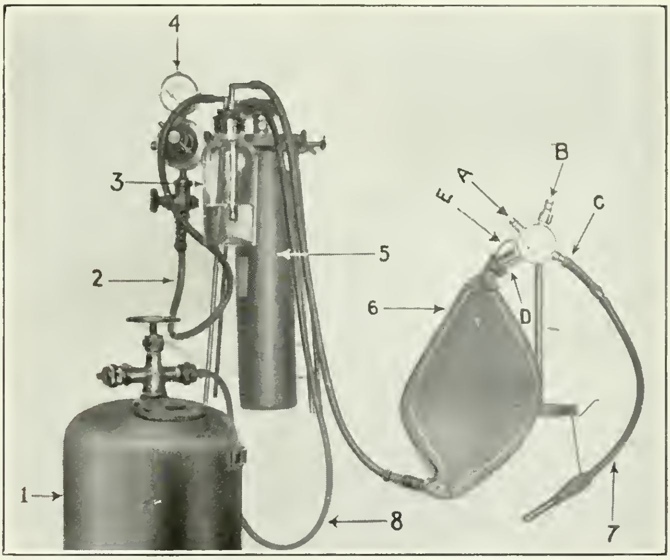
According as opening D, E, or A is placed in communication with the tube C emerging from the cylinder, the patient inhales, from the respiration bag and exhales through B into the external air or rebreathes back

FIG. 1.



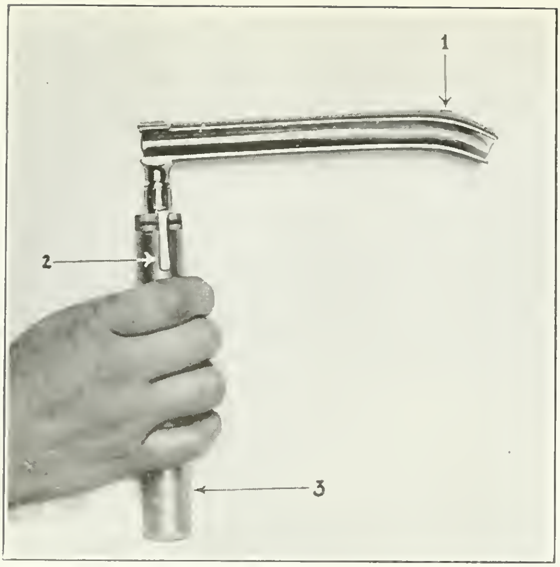
Intratracheal catheter surrounded by distensible rubber bag for occluding the trachea.

FIG. 2.



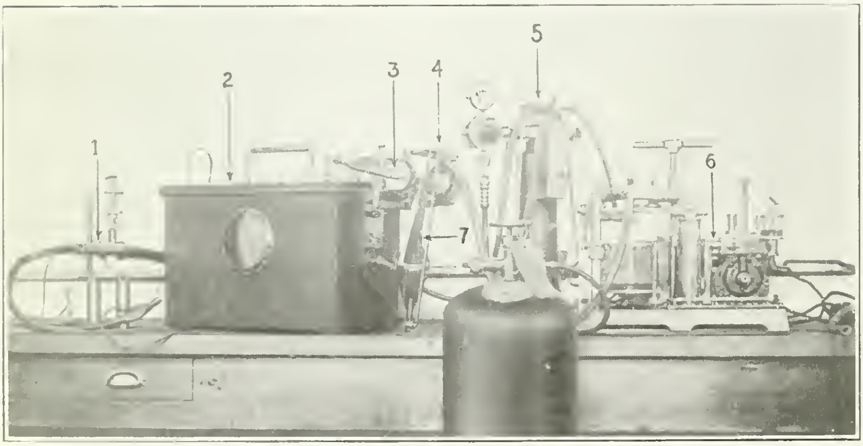
Arrangement for apparatus for intratracheal anæsthesia by nitrous oxide and oxygen. 1, oxygen tank; 2, rubber tube conveying nitrous oxide from the reducing valve (4) to the wash bottle (3); 5, nitrous oxide tank; 8, rubber tube conveying oxygen from the oxygen tank (1) to the wash bottle (3); 6, respiration bag; 7, intratracheal catheter. A, B, C, D, and E, openings in valve controlling the amount of rebreathing.

Fig. 3.



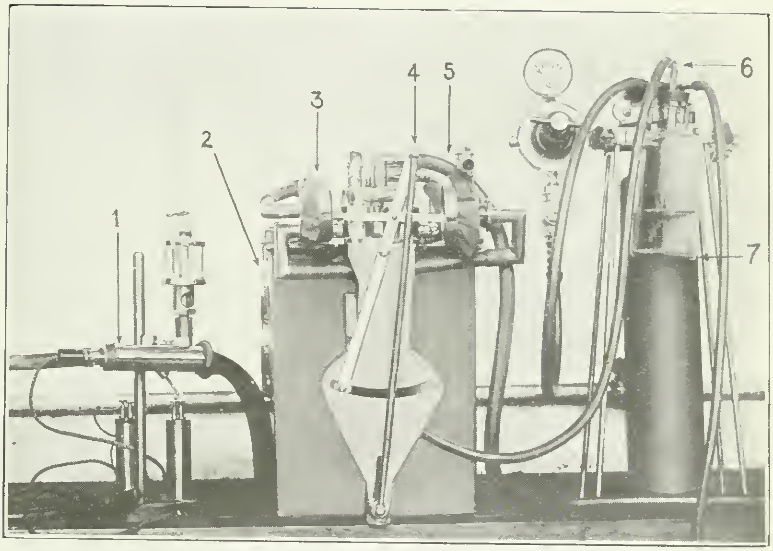
Speculum for catheterizing the trachea; 1, lamp; 2, spring which closes the circuit in the dry cells contained in handle (3).

Fig. 4.



Arrangements for apparatus for nitrous oxide anæsthesia under conditions of positive pressure. 1, valve controlling amount of rebreathing; 2, aluminum box containing respiration bag; 3 and 4, tambours controlling the position of valves which permits of rise and fall of pressure within the box (2); 5, nitrous oxide tank and reducing valve; 6, motor; 7, spring controlling height of pressure within box (2).

Fig. 5.



Arrangements for spring, tambours, and valves attached to the end of aluminum box described in Fig. 4. 1, rebreathing valve; 2, aluminum box; 3 and 5, tambours controlling position of valves; 4, spring controlling height of pressure within box; 6, nitrous tank with reducing valve attached; 7, wash bottle measuring the flow of nitrous oxide and oxygen.

and forth from the inhalation bag or may breathe pure air. In occasional cases, in which a more profound anæsthesia may be needed for short intervals, the action of the nitrous oxide may be intensified or pieced out by dropping a few drops of ether into the cylinder. Provision is also made by means of a little electric heater within the cylinders for rapid volatilization of the ether and the prevention of the condensation of moisture on the mica valves.

One-quarter of a grain of morphine and one-hundredth of a grain of atropine are administered one hour before the operation. Better than morphine is narcophine, which has given greater satisfaction.

The back of the tongue is touched with 10 per cent. cocaine. The patient is then anæsthetized, preferably by chloroform, in the usual manner and the catheter inserted into the trachea. This may be accomplished by means of the Jackson direct laryngoscope so modified that it is deficient at the side in a manner permitting of the withdrawal of the instrument without the necessity of pushing the catheter through it. By the use of such an instrument it is possible to insert the catheter without thereafter detaching it from the tubing connecting it with the gas bag.

The speculum represented in Fig. 3 is a convenient instrument for catheterizing the trachea. The curve is just enough to still permit of the direct view of the larynx and yet to direct the distal end of the catheter forward into the larynx. The lamp of this speculum is illuminated by dry cells contained in its handle.

After the tube has been inserted into the trachea, its external end is attached to the outlet tube of the three way valve which has been previously attached to the stand. The little rubber bag around the trachea is distended and the anæsthesia will now proceed uninterruptedly with nitrous oxide and oxygen alone and will give efficient relaxation in the normal individual for all the usual abdominal or mouth operations.

The rubber bag distended around the catheter, prevents the inhalation of blood and mucus into the trachea and in no way adds to the danger of the procedure, as the pressure of the gases can never exceed that in the inhalation bag. Two provisions prevent the gases in the bag from rising above the atmospheric pressure. First, the safety valve introduced between the respiration bag and the mixing bottle. Second, the respiration bag itself, which cannot become overextended without its being noticed by the anæsthetizer.

Rebreathing is an important feature of this method of anæsthesia—all that remains for the anæsthetizer to do after the intratracheal catheter has once been introduced into the trachea, is to turn the three way valve back and forth between the breathing tube (E) and the tube (D) as the respiration bag empties and fills. About one-half the time the average patient is rebreathing.

The dimensions of the catheter are important. It must have a lumen of at least $^5/_{16}$ inch. The author has used a very thin-walled, flexible metal tube covered with a piece of Penrose drainage tube.

Further experience with this method has demonstrated that care to avoid traumatism during the insertion of the catheter is necessary; and moreover that even though nitrous oxide alone be used as the anæsthetic it is possible for the anæsthesia to be complicated by pneumonia in those cases in which this complication is to be feared.

Nevertheless in properly selected cases this method of anæsthesia is a useful one.

B. BY NITROUS OXIDE AND OXYGEN UNDER CONDITIONS OF DIFFERENTIAL PRESSURE.

It will be appreciated that successful anæsthesia by the method previously outlined depends entirely upon active respiration by the patient. It is for this reason that narcophin, which exhibits a much less toxic effect upon the respiratory centre than morphine, has been found so valuable as a preliminary narcotic and that it is advised to give atropin if a preparatory injection of morphine is depended upon.

If the pleural cavity is opened and active respiration is rendered impossible, the lungs will be unable to fill and empty themselves with the gases during inspiration and expiration. In order to permit of passive inflation and deflation of the lungs with nitrous oxide and oxygen when the chest has been opened and also without that extravagant waste of the gases which is incidental to true intratracheal insufflation, provision has been made for exerting an alternating increase and decrease of pressure upon the outside of respiration bag described in this paper.

The arrangement adopted to produce this effect has been perfected in conjunction with the catheter and special devise for obstructing the trachea described in this article though it may be used in connection with a simple face mask. It provides for true artificial respiration synchronously with the patient's respiration, in other words, merely accentuating the patient's efforts of respiration.

The gases are forced in and out of the respiration bag by the alternating pressure upon it with provision for any desired amount of rebreathing as though the patient were doing his own breathing.

Actually, inspiration alone is assisted. Provision has been made for the loss of that amount of expired air in the passage back to the respiration bag which it may be necessary to replace from the gas tanks.

These results are accomplished by inclosing the respiration bag in an air-tight aluminum box, Figs. 4 and 5 (2).

By means of the attachment at one end of the box of which the important parts are four valves, a spring and two flaccid rubber tambours (3 and 5), air from the insufflation apparatus is allowed to pass alternately into the space around the bag within the box and outside the box into the room. When the air passes into the box it increases the pressure around the respiration bag which contains the nitrous oxide and oxygen. This increase of pressure is transmitted to the gases within the bag so that they are forced into the patient's lungs. It must be borne in mind that there is, of course, no communication between the interior of the respiration bag and the space enclosed outside of the rubber bag by the aluminum box. When the pressure within the box reaches a certain height for which the spring (4) may be set the air blows out the rubber tambour and reverses the position of the four valves. This reversal of the valves occurs suddenly, inasmuch as the rubber diaphragm cannot start its movement until the resistance of the spring is overcome; again the resistance offered by the spring is greatest at the extreme positions of its swing. In the reverse position of the valves the current of air from the machine no longer enters the box, but exhausts in part into the room and in part into the space enclosed by the second tambour. The stop-cock controls the amount of air acting on this tambour and, consequently, the time when the membrane of this tambour blows out, changing the valves back to their original position. It will be appreciated that the speed with which the position of the valves is changed back to their original position depends only in part upon the second tambour. If a minus pressure suddenly occurs within the aluminum box, this will tend to suck in the first tambour which of itself tends to change the position of the valves back to the first position permitting the entrance of air into the box. Because of this fact there is a strong tendency for the increase and decrease of pressure within the box to be synchronous with respiration.

The synchronism of the movement of the valves with respiration depends upon the fact that the changes in the pressure of the gases within the rubber bag transmit themselves to the space outside the bag and within the aluminum box and so to the rubber tambour. The piece (1) is a valve permitting of the loss of any desired amount of the gases exhaled from the patient's lungs. It permits, in other words, of any desired amount of rebreathing from no rebreathing up to complete rebreathing of the expired air. We have therefore, in this apparatus a means of true artificial respiration with whatever gas (either air or nitrous oxide and oxygen) that is allowed to fill the respiration bag.

Should it be desired at any moment to change from nitrous oxide to pure air, respiring the patient with only the latter, this change may be accomplished by moving a slide valve, which immediately connects the intratracheal catheter with the space outside the respiration bag.

It is important to remember that the only manner in which a minus pressure may be produced within the box is by a sudden inspiratory effort by the patient. While there is provision for artificial suction of the air out of the aluminum box yet the mechanism by which the valves are changed from the position permitting of expiration by the patient to that of inspiration is not accomplished by artificial suction. Particularly when the chest wall is open if during artificial respiration the expiratory phase depends upon an artificial suction a complete collapse of the lungs will result. This complete collapse combined with the replacement of the negative intrathoracic pressure during inspiration with a positive pressure which compresses the pulmonary vessels will so obstruct the pulmonary circulation that death will result in a little while.

For this reason the author believes that the principle of an extensively advertised machine for artificial respiration certainly when the chest is opened is a wrong one. It is much better to depend upon the elasticity of the lungs even when the chest is closed for expiration, except in rare intervals and then only for a few respirations.

During artificial respiration with the chest wall open as in thoracic surgery, it is absolutely necessary to depend alone upon the elasticity of the lungs for expiration and to absolutely avoid artificial suction.

The above described apparatus may be used with the intratracheal catheter provided with the little rubber occluding bag described in this article.

It may, however, be used in connection with a tightly fitting mask and therefore without the intratracheal catheter. When used with a mask it is better to provide the mask with an elastic band which passes around the head and by which it is tightly held over the mouth and nose.

Used in either manner, the apparatus furnishes a method of administering nitrous oxide and oxygen by true artificial respiration in a manner which will be synchronous with any of the more forcible respiratory efforts of the patient.

It will simply accentuate the voluntary efforts of inspiration and expiration. It increases the safety of nitrous oxide anæsthesia and for two reasons its efficiency. The first reason is that it administers the gas under conditions of increased pressure. The second is that morphine may be used with greater freedom with it. The preliminary injection of morphine has been always viewed as almost a necessary adjunct to the best nitrous oxide anæsthesia. Unfortunately morphine diminishes the respiratory movements to a marked degree and with them the power of the patient to inhale regularly the gas. This disadvantage, however, is not noticed if the gas may be introduced under conditions of differential pressure. The safety of nitrous oxide anæsthesia is increased because failure of respiration cannot take place, and may at once be relieved by respiration with air.

The slide valve described ensures against the possibility of excessive pressure within the lungs. Its exhaust opening is simply closed on inspiration, being guarded by a piece of mica which raises upon the slightest expiratory effort. During inspiration the spring never allows the pressure within the respiration box to exceed 10 mm. of Hg.

DEATHS FROM ANÆSTHESIA

AND LESSONS TO BE DRAWN FROM THEM.*

BY F. J. COTTON, M.D.,
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In this paper I shall not try to come to final conclusions, for even in the single case, imperfectly observed in the emergency, it is often hard to interpret just what happened.

First, however, one thing is clear. The fact that I or any surgeon can report ten deaths and three close approaches to death from anæsthesia personally observed in the course of two or three years is of itself evidence that the old delusion of the safety of anæsthesia can no longer be maintained.

It has been maintained in the past by charging off to shock, heart failure, intercurrent pneumonia, alcoholism, etc., the great majority of cases that we ought not honestly regard as due to anything but anæsthesia.

Perhaps the propriety of classifying some of my list of cases as anæsthetic deaths may be brought in question—all I can say is that if they had not been anæsthetized the trouble would not have occurred.

First, as to the pneumonias, I have here cited two cases only. At least one other case, recent, died of post-operative lobar pneumonia but following an interval of a few days and preceded by delirium tremens, and at least two others of slow bronchopneumonic processes following ether.

The two I have selected for mention are as follows:

The first case was that of a young man of twenty-four, a fine specimen physically, who had an acute attack of catarrhal appendicitis. The operation itself was short and uneventful. He "took ether badly," but nothing in particular happened. The next day he showed temperature and bronchitis. The second morning he had a well-defined lobar pneumonia of the right lower lobes, unable to cough without excruciating pain in the wound. After three days he died of toxæmia, but also worn out by the pain of the excruciating, uncontrollable cough.

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* Read before the American Association of Anæsthetists, June 18, 1913.

The second case was in a man of fifty, operated on for gall-stones, an ordinary type operation. He too "took ether badly" and was not in good condition by any means at the close of proceedings. Next day he developed a bronchopneumonia, confluent at the bases, and on the third day after operation died.

Now as to the moral, to my mind it is clear enough. In the hospital in which these cases occurred as in many others there is too much work for the professional anæsthetists to do and many "routine" cases are anæsthetized by junior house-officers. Now these house-officers seem convinced with rare exceptions that if a patient isn't dead—if he is breathing—that that is enough.

Here is where the trouble comes.

Until the etherizer realizes the danger of letting the half-choked patient suck in air and mucus; until he realizes that nothing short of an approximately normal, quiet, unobstructed respiration is good enough—until then, we shall have ether pneumonias occasionally, or more than occasionally, according to the run of the luck and the run of the cases.

We ought to have none but really skilled anæsthetists. This is not yet possible, but we must keep hammering at the kind of anæsthetists we have.

The next case was a girl of six, anæsthetized for me by the family doctor for removal of a needle imbedded in the leg. Save for a slight bronchitis she seemed in perfect health. The day after I was called out of town and only heard the history on my return. The ether recovery had been abnormally slow, with considerable nausea, the child seemed stupid and the next day diarrhœa developed. The condition remained much the same for three days, without temperature, when she suddenly grew worse and her heart went to pieces, the "enteritis" continuing; a fatal result ensued on the fourth day.

The picture to my mind is one of acid intoxication, though this view is not supported by any tests made on the case.

Recently, I have had a like case in which I believe failure to recognize and treat acidosis would have lost the case.

Especially with children we must bear this post-operative or post-anæsthetic complication in mind. Often, no doubt, it is not important if present, but it is well to bear it in mind, and in case of doubt sodic bicarbonate and early feeding by mouth or rectum is harmless and may change the issue entirely.

One death I have seen seemed to be purely from ether poison, presumably from impurities. The patient was an elderly woman, operated on for hernia, who died on the second day, stupid and with a subicteric color. Tests for acid or other metabolic intoxication were negative. Within a week or two of this case there were two other like cases that got well. One of them, a case of my own, showed the skin-color, the slow pulse and hebetude that have been attributed in chloroform poisoning to liver degeneration, chemically induced. At this time I found a cheap brand of ether had been run in on us. I do not *know* that this was responsible, but after we got back to our usual supply no more cases developed.

The moral of this is that the excellent work friend Baskerville has been doing for New York ought in some way to be made available for all of us, and we ought not to be asked to give poison to better the superintendent's expense account.

Two cases I have seen of chloroform poisoning; neither died, but both came close to death.

One, a young negro anæsthetized for a throat operation, stopped breathing before work began, and was resuscitated only by inversion; he did the same thing on a second trial at operation by another anæsthetist for another surgeon.

The second case was in a young man of twenty-eight, rather fat but vigorous and athletic who was being etherized by an experienced anæsthetist who had used anæsthol for the primary stage. Just as the patient was being wheeled in, ether had been substituted. I noted and spoke of the bad color: at that instant he stopped breathing, turned from blue to gray, and his pulse was barely perceptible. Inversion head down and a couple of minutes of artificial respiration restored him to a state justifying further ether and the performance of the slight operation contemplated.

These cases represent the result of chloroform in too high a percentage. They help show why I bar absolutely any chloroform mixture as a preliminary, and why I stick to the Boston dislike of chloroform. At best, chloroform calls for very expert handling, and I see in practice few cases requiring its use.

Next comes a case of a man shot through the lung, diaphragm and abdomen. He took ether well enough till I was all done, then, as he began to come out, he breathed badly, coughed, choked, filled up with blood, and, in spite of my prompt tracheotomy, choked to death from flooding of the trachea. The death was from lung hemorrhage, superinduced by anæsthesia. It was, however, probably unavoidable.

Next comes an inguinal hernia, two days strangulated, in a man of sixty-five, in poor shape. On coming out, after the operation, he began to vomit for the first time, and before anything could be done, died, choked to death by his own vomit. This was no fault of the etherizer, but I suspect I should not have been misled by the previous absence of vomiting, and should have used spinal or local anæsthesia.

In another man, big, hearty, sixty, and alcoholic, I was going to fix an acromioclavicular luxation. As he went under the ether, I remarked to a passing colleague that this sort of short-necked, wheezy man ought really to be anæsthetized by the intratracheal method. I did not use it because the anæsthetist at hand was unskilled in its use. There was much trouble with breathing, much mucus, etc. The anæsthetist with my permission switched to chloroform with a little improvement only. Presently breathing stopped abruptly. Instantly I did tracheotomy. The patient then went all right, but later developed inhalation pneumonia and died after six days.

The moral is that all anæsthetists (and my man that time was a professional) should be trained to *all* methods of anæsthesia, not one or two.

There was a case of a frail young girl (seventeen years) to be operated on for tuberculous neck-glands. I saw the intratracheal introduction, saw the administration. Constantly there was trouble with coughing, straining, and partial extrusion of the tube. It was not my case so I left some remarks behind and went away. Later I was told that the tube was removed and a cone substituted. Shock, hemorrhage and the continued strain brought about a fatal end that night.

So far as concerned the intratracheal part, it was simple. At no time did she have ether enough to lose even the edge of her laryngeal reflex.

The moral is that intratracheal work is for the man who knows how.

One case usually charged to gas-oxygen anæsthesia and to shock, at the hospital—a plating of the femur that proved long, rough, and difficult—that led to the death of a vigorous middle-aged man under the picture of heart collapse sixteen hours after operation without any primary symptoms of shock or other trouble—this case I believe belongs to the fat-embolism series and has nothing to do with anæsthesia except coincidence.

One case, to close—a death from local anæsthesia. One of my colleagues did a Bassini for a hernia in an elderly patient, in poor general condition, under local anæsthesia with cocaine and adrenalin solution, the routine mixture of the hospital. The tissues blanched excessively during the operation; next day they began to blacken; presently the gangrene became infective and death was from sepsis.

This means that while adrenalin as an adjuvant to cocaine is all right for mucous membranes, its use in the tissues is not without risk.

Now I present this haphazard list of cases and the also haphazard remarks, not with the notion of directly solving any problems, but to promote discussion. I still have my affection for the gas-oxygen-ether combination—still have seen no trouble from it. May I suggest that if we recognize and admit freely the troubles from ether, etc., as we ordinarily meet them, then go on to learn by full discussion the things to avoid, the possible dangers in handling gas-oxygen, intratracheal, and intrapharyngeal methods, and the more modern methods of handling intraspinal and extradural injections we shall presently be in fairly good position to lessen the accidents and the disagreeable incidents of anæsthesia.

THE QUESTION OF ANÆSTHESIA IN GOITRE OPERATIONS.*

BY WILLIAM SEAMAN BAINBRIDGE, M.D.,

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Introductory Remarks.—The wonderful achievements which have marked the progress of surgery during the past few years finds an especially brilliant illustration in the domain of the operative treatment of goitre, from the radical or curative to the symptomatic or palliative procedures. On the basis of new discoveries along biological lines, or because of special refinements of technic, the surgery of the thyroid gland has reached a certain stage of perfection, with constantly improving results.

The question of anæsthesia in goitre operations, on the other hand, is still an unsettled problem, and is, therefore, in the foreground of surgical interest. The particular method of inducing insensibility to pain in these operations which is given the preference varies according to the personal experience or otherwise acquired opinion of the surgeon. The different procedures now in use have been employed with more or less success, but it would seem reasonable to assume that the most satisfactory results may be obtained by the method of anæsthesia or analgesia which is most nearly in keeping with the principles involved in the surgical treatment of goitre.

It is not my purpose in this contribution to do more than touch upon the technical side of thyroid surgery. I shall confine my brief consideration of the subject rather to such aspects as are directly concerned with the selection of the anæsthetic or the method of administration.

Surgical Considerations Which Influence the Selection of the Anæsthetic Agent or Method of Administration.—Certain surgical problems, always to be reckoned with, are particularly important in the surgery of the thyroid gland, not only because of the location of the operative field, but because of the psychical aspects which may be involved. These problems, which need only be mentioned here, are influenced more or less directly by the anæsthetic, and it is therefore of the utmost importance that they be given due consideration. Chief among them are the following: (1) The maintenance of normal blood-pressure; (2) the determination of the amount of dyspnœa; (3) the avoidance of injury to the recurrent laryngeal nerve, or other nerves in the vicinity; (4) the control of hemorrhage; (5) the lessening of post-operative shock; (6) the lessening of psychic shock.

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* Read before the American Association of Anæsthetists, June, 1913.

Selection of Anæsthetic and Method of Administration.—The following general procedures enter into consideration in the selection of an anæsthetic agent or a method of administration for any operative procedure upon the thyroid gland: (1) General anæsthesia; (2) anoci association; (3) local anæsthesia; rectal anæsthesia (ether in oil).[1]

General Anæsthesia.—It is interesting to note that those whose practical work has been the most extensive are also those who are most strongly inclined toward methods of anæsthesia other than general narcosis. Kocher, with his enviable record of over 5,000 goitre operations, is unconditionally opposed to general anæsthesia in these cases. The disadvantages of general anæsthesia, according to Kocher, consist in the following:

(1) The danger of too much lowering of the blood-pressure when the heart action is weak. The falling of the blood-pressure below 120, as compared with the average of 150 mm. Hg., measured with the Riva-Rocci apparatus, endangers the outcome of the radical operation. Measuring the blood-pressure is one of the necessary preliminaries to any method of general anæsthesia in goitre operations.

(2) The difficulty of ascertaining the degree of dyspnœa.

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[1] Since the preparation of this paper Dr. James Tayloe Gwathmey, in a series of 50 general surgical cases, has employed a mixture of ether in oil, administered by rectum. The anæsthesia thus induced, according to this authority, has been almost ideal, simulating normal sleep. If further experience bears out these results, the method gives promise of being one of the best, if not the very best, for goitre cases. The writer is testing the method in a series of neck cases.

(3) The increased risk of accidental injury to the recurrent laryngeal nerve.

(4) The lessened surety of a perfectly aseptic course, for the dressings, and with them the wound itself, are more apt to become contaminated by vomited matter.

Another very serious objection against general anæsthesia in goitre operations is the patient's liability to a severe attack of asphyxia, in consequence of excitement at the beginning of the narcosis, more particularly in cases with stenosis of the trachea or paralytic symptoms on the part of the laryngeal nerves.

The condition of the heart and lungs undoubtedly adds to the risk of general narcosis in a considerable number of goitre cases. Grave risk is involved in aged goitre subjects, with much enlarged thyroids, softening of the trachea, chronic bronchitis, and irregular weakened heart action. General narcosis has also been held responsible for fatal syncope at the beginning of the operation, more or less sudden cardiovascular symptoms, bronchial disturbances, and pulmonary complications. The vomiting and retching after chloroform or ether anæsthesia are extremely distressing and painful, and may induce very troublesome complications, such as severe secondary hemorrhage. The administration of chloroform is sometimes followed by albuminuria, and its toxic action is apparently increased through degeneration of the thyroid gland. Post-operative complications of a toxic character after the employment of general anæsthesia are also referred to by Kocher, who attributes the very low mortality in his last series of one thousand goitre operations to the omission of the general anæsthetic.

Goitre operations under general narcosis expose the patient to the danger of nerve-contusion through ligatures or clamps, followed by spasm of the glottis, with secondary paralysis. It should also be emphasized that a paresis which has existed prior to the surgical interference may become aggravated into a total and persistent paralysis through traction incident to the operation under general anæsthesia.

The number of surgeons who persist in the belief that there is a tendency to exaggerate the dangers of general narcosis in goitre operations will undoubtedly diminish on the basis of increasing practical evidence. It is certainly suggestive that authorities such as Kocher, Rehn, Socin, Jaboulay, and others, unconditionally oppose general narcosis in these cases. Their operative records bear eloquent testimony to the soundness of their views.

If, for any reason, general anæsthesia must be employed, the essence of orange-ether proposed by Gwathmey, or any other vapor anæsthesia, is the most satisfactory. Vapor anæsthesia, with the apparatus first proposed by Gwathmey, in 1910, provides for the giving of a smaller amount of the anæsthetic than is required with any other method. Excitement is usually absent or inconsiderable, and unpleasant after-effects are altogether absent in ninety per cent. of the cases. All patients can be narcotized within five minutes, and a satisfactory continued narcosis is always maintained. The addition of one to three drops of the oil of orange, or three to five drops of the essence of orange (25 per cent. oil of orange and 75 per cent. deodorized alcohol) serves to disguise the odor of the anæsthetic very efficiently, in this way diminishing the undesirable side effects incident to the inhalation of the gas, and approaching this method to the principle of Crile's anoci association.

Anoci Association.—The *anoci association* of Crile introduces new features into the aspect of anæsthesia, by taking into consideration the psychic side of the patient. The method consists in the injection of local anæsthetics into the field of operation, in addition to the other preparations, prior to the giving of the general anæsthetic. The procedure is based upon the observation that the psychic excitement of the goitre bearer is one of the greatest obstacles in the way of operative success. Observation of Crile's work is most interesting and cannot fail to impress the spectator with the desirability of utilizing the elements of anoci association in the operations under consideration. Crile claimed and showed that the general anæsthesia, more particularly with ether, fails to protect the brain cells against exhaustion from the operative traumatism. The shock incident to fear, the shrinking of the mind no less than the flesh, and the subconscious response to pain before and during the operation, which otherwise induce a discharge of vital energy, are avoidable by the application of local anæsthesia, which bars the way of the harmful associations through the intervening nerve trunks to the brain. In connection with a local anæsthetic, the anoci method of Crile acts most beneficially through its merciful withholding, for the time being, of the messages of distress that are constantly being conveyed to the helpless brain by the nerves. "The psychic factor," according to Crile, "which is the most important in the surgical risk, may be eliminated by 'stealing' the gland. When eliminated, the operative risk seems to be greatly reduced."

Local Anæsthesia.—The advantages of local anæsthesia in goitre operations were first emphasized by Socin, and his recommendations were endorsed by Bier, Madelung, and other operators of renown. Kocher, who is an earnest advocate of local anæsthesia, is fortified in his position by an experience in a series of 5,000 goitre operations. Among 603 uncomplicated, but in part very difficult goitres, in his last series of 1,000 cases, no patient died. The same applies to 19 operations on recurrent goitres, which are apt to prove especially troublesome to the operator, on account of cicatrices and adhesions. Of 26 incisions for malignant struma, all recovered. Definite end results could be traced in only 320 of Kocher's operative cases, with a complete cure in 150 patients, while 148 are considerably improved although still showing individual symptoms of the disease. The results were unsatisfactory in only 22 cases, either because the operation could not be completed, or because recurrences followed (in five per cent.), or on account of secondary disturbances of thyroid origin failing to subside after operation.

The possible advantages of local anæsthesia, in my experience, are the following:

(1) The hemorrhage is considerably diminished.

(2) A free survey of the field of operation is provided,

and movements of the throat at critical steps may be prevented by instructing the patient to hold his breath.

(3) The inferior laryngeal nerve is absolutely protected, by the possibility of phonation in the conscious patient. This is doubly important in view of the fact that clamping or ligatures in the immediate vicinity of the nerve may mean a persistent hacking cough as a sequel to the operation.

(4) Requiring a better control of the technic on the part of the operator, local anæsthesia safeguards the patient against all unnecessary brutalization of the tissues.

(5) The strain on the kidneys is lessened, as they are not called upon to eliminate the general anæsthetic, and may be flushed through the stomach, by the administration of abundant fluid, when the need is greatest, immediately after the operation.

(6) Avoidance of post-operative vomiting, and thereby diminution of the risk of secondary hemorrhage.

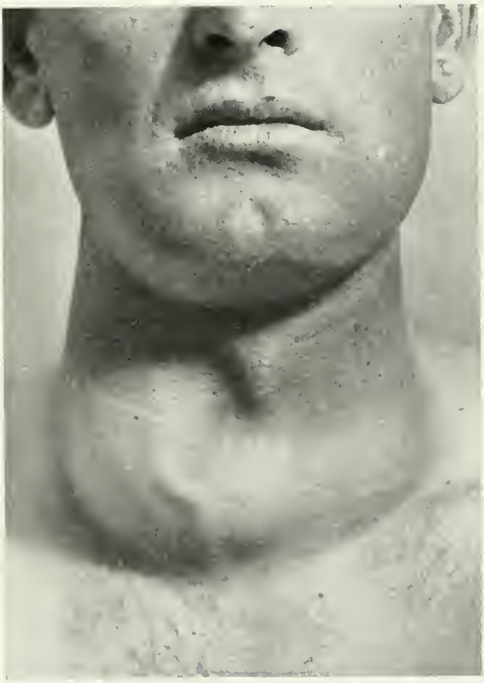
(7) Less elaborate technic, as local anæsthesia does not involve the same refinement of detail as general narcosis.

(8) The risk of operative shock is partly eliminated, as patients are apt to consider the operation less serious under local than under general anæsthesia. The importance of this is illustrated by the occurrence of death in patients while being prepared for general anæsthesia, the fear of the operation being intensified by the thought of "going to sleep."

(9) Elimination of the dangers of all general anæsthetics.

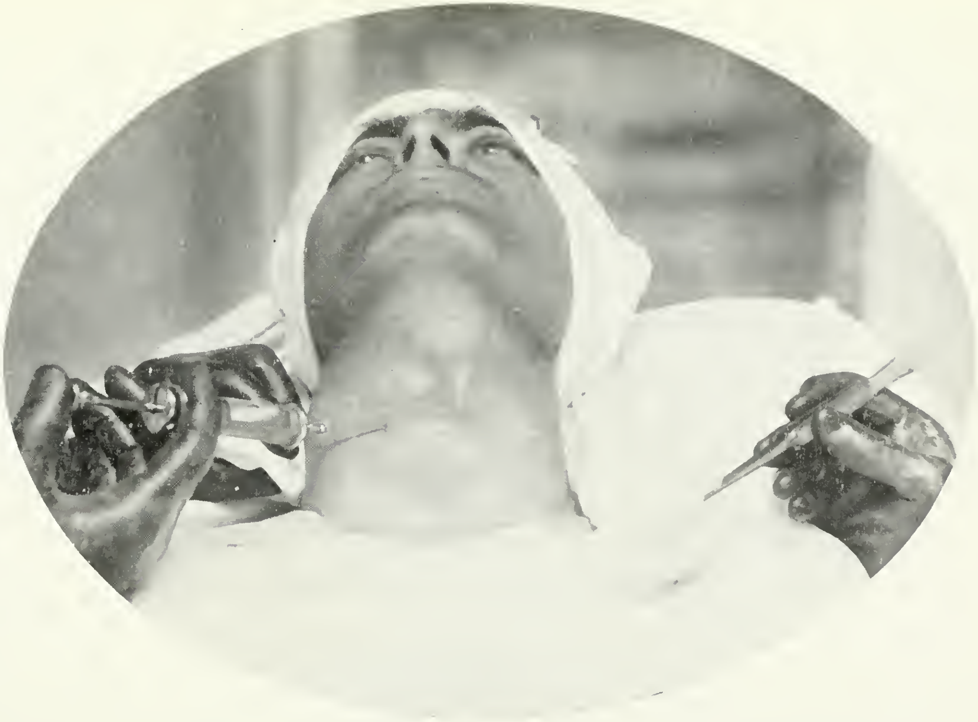
In a recent paper on the surgery of the thyroid gland (1913), Berry emphasizes that much depends upon the anæsthetic and much upon the patient. In the opinion of this operator, the method which is the most suitable of all, for the severe type of case, is local anæsthesia, provided that the patient is willing to submit to operation under these conditions. The fact that the patient can drink freely during and immediately after the operation, is regarded by him as the main advantage of local analgesia, diminishing as it does the tendency to excessive post-operative tachycardia, which is one of the principal dangers after surgical manipulation upon goitres.

Fig. 1.



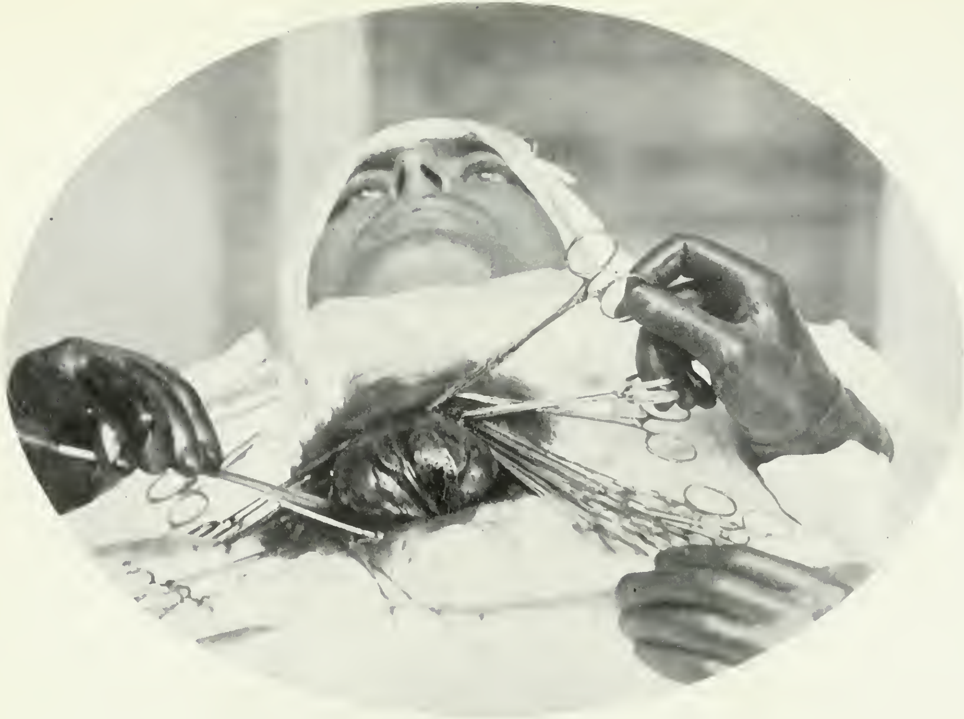
Exophthalmic goitre. Before operation.

FIG. 2.



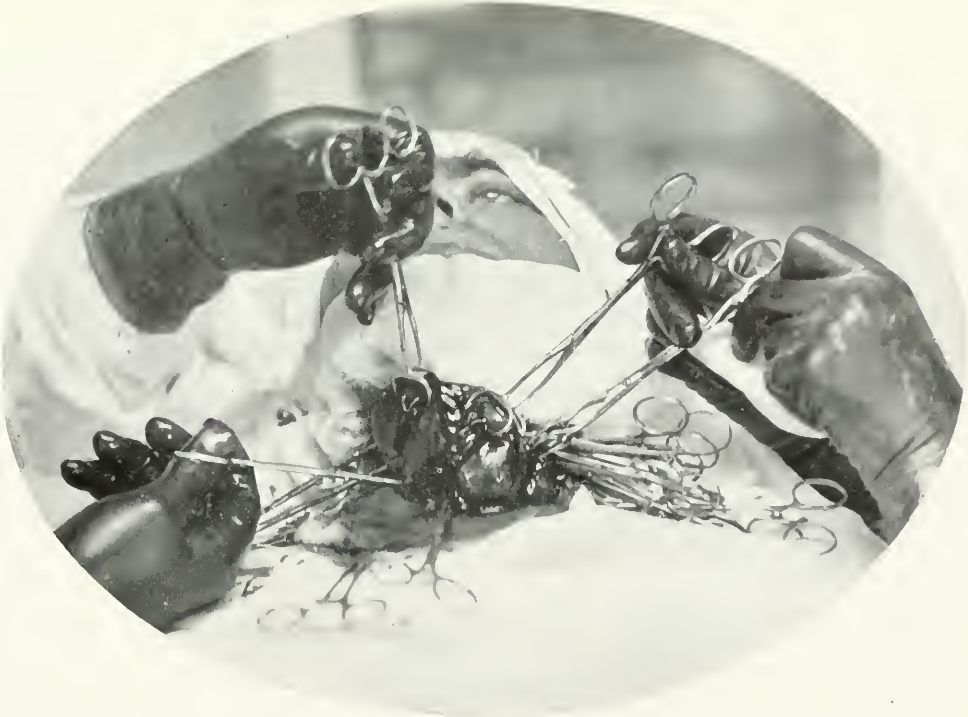
Thyroidectomy. Injecting local anæsthetic, novocaine, 1 per cent. in skin; ¼ per cent. in deeper structures.

FIG. 3.



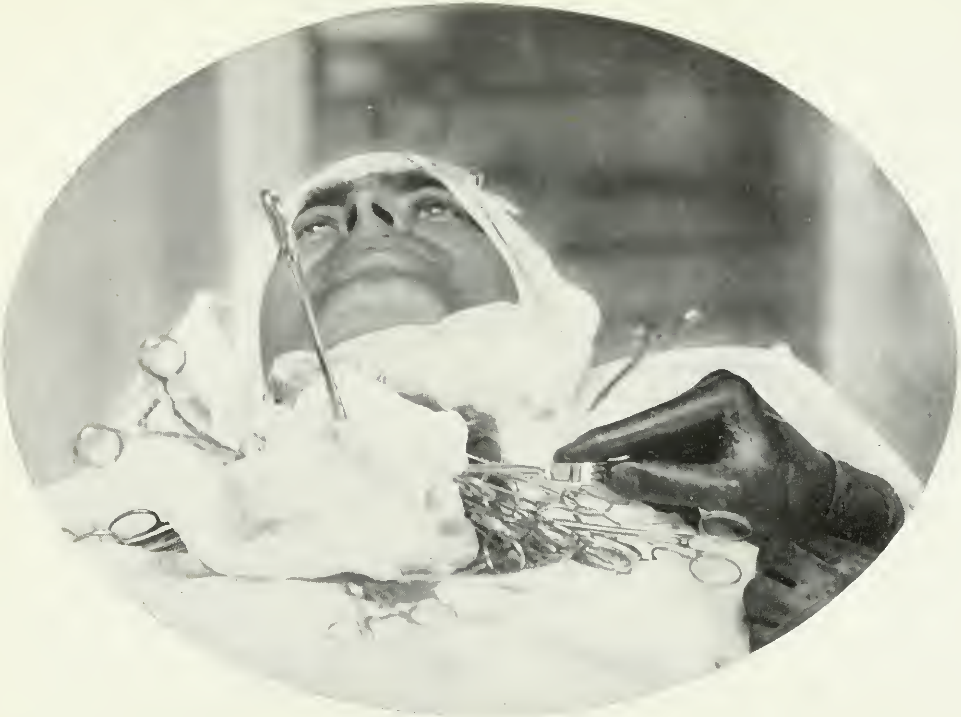
Thyroidectomy under local anæsthesia. Goitre exposed and tumor dislocated from behind sternum and brought up into wound.

Fig. 4.



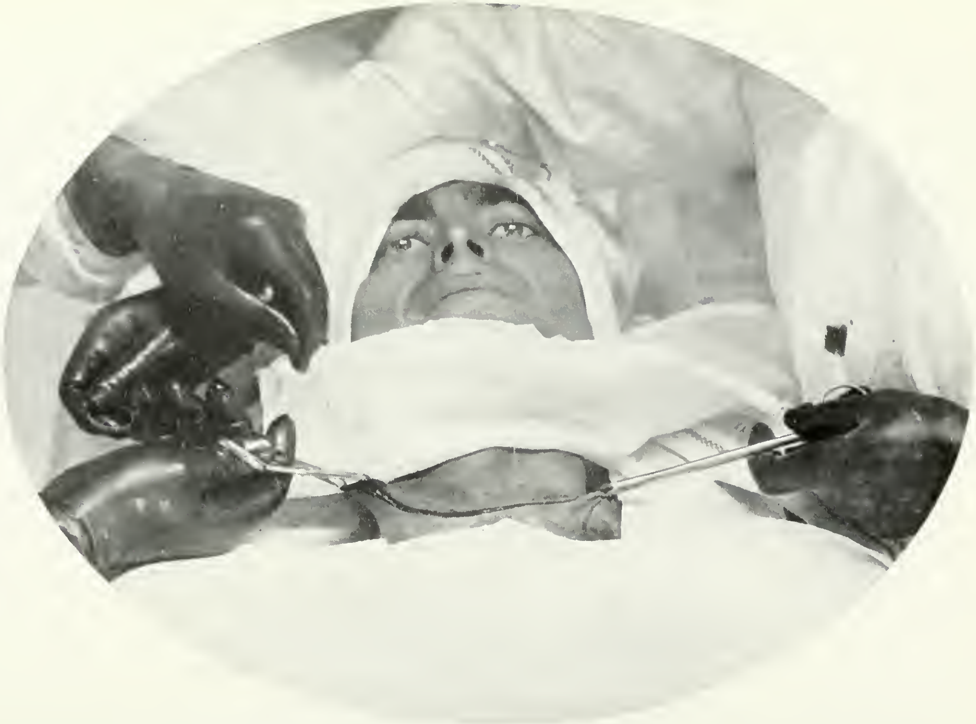
Thyroidectomy under local anæsthesia. Goitre-holding forceps in place.

FIG. 5.



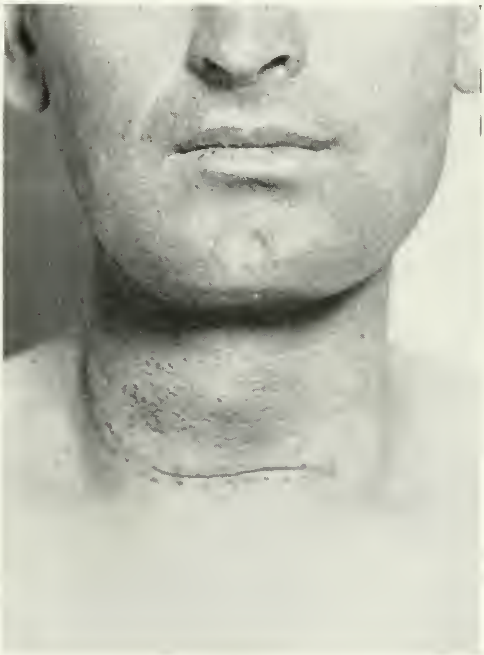
Thyroidectomy under local anæsthesia. Stopping oozing with hot applications to the raw surfaces after extirpation of tumor.

Fig. 6.



Thyroidectomy under local anæsthesia. Deeper structures sutured. Skin ready for closing.

Fig. 7.



Thyroidectomy. Twenty days after operation.

In discussing the goitre operations of the five years between 1905 and 1910, in the Surgical Clinics of the Berlin Charity Hospital, Walz accords the preference to local anæsthesia. There was only one death among 120 benign goitre cases. In the experience of Enderlen, local anæsthesia failed in only a single instance, in the case of a child, among 166 goitre operations, during 1909. In the Clinics of Rehn, in Frankfort-on-the-Main, the preference is accorded to local anæsthesia in these cases. In reporting 510 and 452 goitre operations, respectively, from the Innsbruck Surgical Clinics, 1909–1910, Schloffer states that local anæsthesia with different agents proved very satisfactory. Fairlie Clarke, in England, had very favorable results with local anæsthesia in goitre operations, such as excision of one-half of the gland or ligature of both superior thyroid arteries.

As a pupil of Kocher I have been interested in local anæsthesia in goitre surgery, and added experience has steadily strengthened my convictions concerning the expediency of this method.

Manipulations on the goitre are said to be but slightly painful in themselves, the actually painful steps of the operation being limited to the incision of the skin, and the displacement, or so-called luxation, of the goitre. It is undoubtedly possible to operate painlessly, or very nearly so, in a large number of cases, by means of local anæsthesia. The skin incision is thus rendered absolutely painless, and in the further course of the operation, the patient is troubled not so much by pain, as by a sensation of tightness and pressure, during the delivery of the goitre. Serious and protracted goitre operations have been performed under Schleich's infiltration anæsthesia, without causing special pain to the patient.

The employment of local anæsthesia may place a greater strain upon the operator, whose work may be hindered by the defensive movements of the patient, on account of the pain due to traction upon the nerves or the application of ligatures to blood-vessels. It is here that combination of the related methods of local anæsthesia and anoci association will exert a beneficial effect, by diminishing the nerve strain and shock of patients both during and before operation.

The same purpose is served by proper preliminary medication, and by the personal contact of surgeon with patient, confidence which results in a state of nerve-calm.

The possible disadvantages of local anæsthesia, in a small number of cases, consist in the added difficulty and length of the surgical procedure, the increased demands upon the operator's skill and self-possession, and the intractability or hysterical condition of certain patients. Other objections, such as an unfavorable influence of the local injection upon the repair process, are not tenable.

Goitre must be regarded as a surgical disease, and operative intervention naturally calls for the control of pain. The physician who has the comfort and safety of his patients at heart will give them the utmost benefit of what is, perhaps, the greatest blessing modern chemistry has bestowed, namely, the arbitrary arrest of pain in the field of operation, by means of local anæsthesia.

Any of the local analgesic agents may be employed—stovaine, cocaine, novocaine, etc. In the case illustrated herewith, novocaine was employed, 1 per cent. in skin, and ¼ per cent. in the deeper structure. The case was one of exophthalmic goitre, with large vascular thyroid, and with marked heart and eye symptoms. Preliminary medication of ¼ of morphine, and 1/150 of atropin, is given half an hour before operation.

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STOVAINE SPINAL ANALGESIA IN PRISON SURGERY.*

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THE use of stovaine as an anæsthetic agent at the Sing Sing Prison hospital dates back to 1908 when Dr. Fred E. Lettice, the then Prison Physician, encountered a situation which endures in the prison system of New York State, namely, the utilization of convict help to that extent that even in the various prison hospitals no civilians are employed. This system, while most creditable to the general prison administration, works rather against the surgical operator, as the absence of trained assistants is a serious handicap. Dr. Lettice not caring to assume the responsibility of the oversight of a convict administering ether was led to experiment with stovaine. An idea as to how well he succeeded may be gained from the fact that to-day no operation upon the body below the level of the umbilicus is performed under any other anæsthetic agent than stovaine. The results in the past five years have been particularly brilliant.

The practice of medicine in penal institutions is, naturally enough, similar to other institutional medical practice. Yet, in no variety of institutions is the degree of superstition of the inmates as marked. The old bugaboo of the "black bottle" still holds sway. The malingerers and the members of the new generation are the ones that continually present on sick call. Let a death occur in one of the wards and invariably a number of the patients in that ward speedily recover and request to be discharged. This in illustration of the fear of the hospital held by the great majority of the prisoners.

The foregoing facts are simply mentioned to call attention to the psychological side of prison medicine and also to bear out my statements regarding " stovaine." Given a certain surgical case having undergone operation and a post-operative death occurring, the convict body to a man would claim that the stovaine was responsible, and, as a direct result, surgical procedure would be looked upon with a most pronounced degree of doubt by the convicts. As no post-anæsthetic death has ever occurred, and as the results have been so uniformly successful, we are often confronted with complaints to the Warden that we are negligent, and, in fact, it is not an unusual thing to have a convict urgently insist upon an operation.

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* Read before the American Association of Anæsthetists, June 18, 1913.

To one versed in prison medicine the foregoing carries a potential story. It tells that the fear of surgery has been removed from the minds of probably the most skeptical, superstitious and doubting class on earth, namely, the convict body of a large prison. The reason for the assumption of this attitude is due, not to superlative surgical skill or wonderful nursing, but in fact to stovaine analgesia. The fact that its use was instituted simply as an expedient, due to the lack of proper assistants, who would be able to administer ether, and the fact that to-day its continued use has become a routine, indicates undoubtedly its value.

By many surgeons the use of stovaine has been sharply criticized,—it has been termed dangerous—it has been stated that its field of usefulness is too limited, and many other objections raised to its employment. I do not seek to deny that its use is always unattended by danger, surely in a case in which other agents are strongly contra-indicated the use of any anæsthetic would be attended with a certain degree of risk and this is true of stovaine when employed in depressed physical conditions. When employed in a routine method, the fatality record will be practically negative. It has been my experience that the surgeon who condemns stovaine will admit that in cases of cardiac and renal disease where the use of ether is hopeless, spinal analgesia may be considered, as there will probably be less danger of a death occurring. This reasoning appears to me rather illogical for surely if stovaine is a relatively safe, or rather less dangerous agent than ether, in cases with grave organic lesions, why should it not be more than relatively safe when used in the ordinary routine of surgical practice, and upon cases uncomplicated by some chronic affection. The surgeon, by assuming this attitude, has, therefore, sharply limited the field of usefulness himself, by only utilizing this agent in cases depressed by organic disease. That the field of usefulness is limited is true, yet, nevertheless, from a surgical stand-point, any agent that produces a satisfactory and complete analgesia, which permits surgical procedure below the level of the umbilicus, possesses a rather broad field of application. I have never experimented in producing a high analgesia, but rather have contented myself in trying to improve and safeguard the lower administration of stovaine.

The advantages of the use of this form of analgesia would seem to outweigh the disadvantages.

The disadvantages are:

a. Inability to change the dosage after once being administered. Yet, in cases where stovaine absorption has caused a marked depression this can be controlled by altering position of patient and the hypodermatic administration of strychnine.

b. In prolonged operations there is the possibility of the effects of the stovaine passing. I have been confronted with this situation but twice, and in both instances the wound was being closed, pain being complained of as suture needle passed through the skin. This condition was readily controlled by a hypodermic of morphine. Against the possibility of analgesic effects wearing off before completion of operation, I wish to call attention to a case of large rectal prolapse. Time consumed in excision was 95 minutes, analgesia was perfect for that time and lasted for 35 minutes more.

Against the disadvantages as enumerated, we have the following advantages:

a. Consciousness.—Whether the retention of consciousness is a distinct advantage is problematical. In some cases the patient's knowledge that he is not going to be "put to sleep," but will remain perfectly conscious although insensible to pain, fortifies him, and the attendant apprehension immediately before operation is not so marked. Then, too, during the operation a line may be obtained on the patient's condition by his expression of state of feeling.

b. Perfect analgesia. If spinal tap has been successfully performed, and a free flow of fluid results stovaine gives a perfect analgesia.

c. Absence of post-operative shock. Immediately upon completion of operation a quarter of morphine is given hypodermatically. This practically controls post-operative shock, and delays return of painful sensibility, so that with its reappearance a goodly degree of toleration has been established.

d. Absence of post-operative pulmonary or bronchial irritation. In contradistinction to ether or chloroform there is no elimination of vapor from the pulmonary or bronchial membrane, hence, no factor to cause any inflammatory condition of these structures.

e. Recovery from anæsthesia unattended by stomachic disturbances, as vomiting, retching, etc. Any nausea or vomiting is secondary to the "absorption reaction," is more or less reflex in character, and quite disappears before patient leaves the table.

f. Absence of marked motor restlessness as is present in ether anæsthesia when patient is emerging from anæsthesia. This is due to the fact that stovaine is properly an analgesic agent and consciousness has been retained.

g. Immediate resumption of gastro-intestinal activity. Subsequent to inhalation anæsthesia there is a period of 48 to 72 hours before the stomach will functionate properly, due to the irritation occasioned by and the absorption of ingested ether vapor. The inability to assimilate nourishment occasions a physical depression and causes a nutritional loss that naturally prolongs period of convalescence. Following stovaine analgesia nutriment is commenced eight or ten hours subsequent to operation and diet rapidly increased. This insures a more rapid convalescence.

h. Absence of after effects. The only case developing a nervous lesion subsequent to operation was that of a prisoner fifty-nine years of age, who suffered an attack of apoplexy with resultant hemiplegia four months subsequent to operation for hernia, in which stovaine analgesia had been employed. The prisoner's father and uncle had died of apoplexy, prisoner himself presented a well-marked arterial thickening, gave a history of alcohol, and was the father of nineteen children. The chance that stovaine was the cause of attack in this case would seem to be rather remote. In another case, a prisoner forty-four years of age with a left hemiplegia was operated upon for an inguinal hernia under stovaine with no untoward after-effects.

I will now describe briefly the procedure I follow:

The general preparation of patient for stovaine analgesia does not require much attention. Cases admitted to the hospital for operation on the following day receive soft diet and a dose of magnesium sulphate at bed time. In the morning if the bowels have not moved a soapsuds enema is given. A couple of hours before operation is to begin patient receives a glass of milk and one toasted cracker. It has been observed that if a small amount of food, as described, is given, there is less likelihood of nausea or vomiting after stovaine has been injected.

In a number of emergency cases stovaine has been administered immediately upon patient's reception to hospital without regard as to condition of the gastro-intestinal tract. In these cases it has been well borne, although it is quite usual for the bowels and bladder to involuntarily empty while patient is on the table, due to the stovaine relaxation of the sphincters.

In the *special* preparation for the injection the back is thoroughly scrubbed with tincture of green soap and lower half is shaved. By means of hot water and hot packs all soap is removed and back rinsed in absolute alcohol. A pad about 6 inches square and saturated with alcohol is placed over spinal region at site of injection and held in place by a bandage. This is permitted to remain fifteen or twenty minutes and is not removed until patient is on table in position to receive injection. In the single instance I used iodine the analgesia was not as deep as usual and passed rapidly. I attributed it to the fact that needle carried a minute quantity of iodine with it and it affected the solution.

Outfit and Technic.—The syringe used is the Kny Scheerer Co.'s model of the Bier syringe for spinal anæsthesia. It consists of a glass barrel and metal plunger, and has a capacity of 2 c.c., the needles, two in number and 8 cm. long, are steel with bevelled points. The point of the obturator is bevelled to the same slight angle as the needle point, so that when it is in position within the needle, the needle point is solid. The needle presents a double shoulder, which is flattened on either side and which affords a firm grasp. The shoulder also presents a ground bevelled opening, which receives the tip of the syringe.

The syringe and both needles are wrapped in gauze and boiled in distilled water for fifteen minutes. Formerly a soda solution was used and an occasional defective analgesia occurred, notwithstanding the fact that syringe and needles had been most carefully rinsed and cleaned in hot sterile water.

The syringe is inserted into one of the needles and the contents of ampoule carefully drawn up. The needle is now discarded, syringe held tip up and excess of solution over desired dosage is permitted to escape. Syringe is carefully laid on a sterile towel on dressing table and the other needle used to make puncture.

Patient sits squarely on table with the legs hanging over the side. Head is bent downward on chest, arms to sides and forearms crossed over lower abdomen and resting on thighs. This arches the spine slightly forward and permits entrance of needle in desired interspace. The iliac line represents spine of the fourth vertebra. With this landmark the desired space is noted.

Usually I inject in the space between the second and third, third and fourth or fourth and fifth, choosing the interspace that presents the widest separation. After deciding on point of puncture, assistant sprays it with ethyl chloride and then with the left thumb, as a guide, on the vertebra above the interspace, the needle in the right hand is made to enter the skin at right angles about the middle of the interspace and a quarter of an inch to either side of the midline. It is carried directly forward until it engages the yellow ligament which imparts a definite resistance to the feel. Needle is now advanced further forward, slowly and cautiously until it punctures the dura. As it penetrates the dura the sensation is about the same as would be given by piercing a drum head with a sharp pointed surgical needle. The obturator is now withdrawn and a free flow of cerebrospinal fluid presents. The obturator is replaced, operator rinses hands in sterile water and then again removes obturator. This time the left thumb is placed over the head of the needle. If an amount of fluid approximating two or three drachms has escaped, the syringe containing the dose of stovaine is placed within the reach of the right hand which carefully adjusts it securely to the needle. The plunger of the syringe is now slowly drawn back siphoning out enough fluid to fill syringe and make a solution of stovaine and cerebrospinal fluid. When syringe is filled to capacity plunger is slowly carried forward and the mixed solution instilled within the spinal canal. Upon occasion I have varied this procedure by removing the filled syringe and by slight agitation thoroughly mixing fluid and stovaine. This method seems to work especially well. While the appearance of the analgesia is somewhat more delayed there is undoubtedly less absorption reaction and analgesia when established is satisfactory. After solution has been injected the needle with syringe attached is gently removed. A small piece of adhesive plaster is placed over puncture wound. Patient is permitted to remain in an upright position for two or three minutes and then carefully lowered onto table and a firm pillow placed under head. This method is followed because the solution used is heavier than spinal fluid solution. If the operative measures are directed toward the perineum, rectum, external genitals or extremities there is no departure from this procedure. However, should operation necessitate opening the peritoneum the hips are elevated for a couple of minutes by means of blocks placed under the legs at the foot of the table. This is to permit the mechanical extension of the stovaine solution higher up the canal. Usually analgesia to border of ribs appears within the two minutes. After the injection analgesia usually presents in from five minutes up to fifteen and lasts from three-quarters of an hour up to two hours. The solution employed is the Kroenig formula of "stovaine-billon." It is a 4 per cent. solution of stovaine in 10 per cent. solution of sodium chloride and is sealed in ampoules of 2 c.c. The ampoules are easily rendered aseptic by rinsing in alcohol, they are easy to handle and the solution is apparently a stable one. The billon ampoules have been used exclusively on account of their convenience and also because it has seemed inadvisable to attempt the preparation and handling of a freshly made solution in the surroundings. We have never had any infection of the canal, cord, or adjacent structures following the use of stovaine. The dosage varies according to the case. Eight or ten minims suffice in the slight operations upon the external genitals. In appendectomy and herniotomy a heavier dose is employed. I have at times used 25 drops. The comparatively large dosage has been used as I never administer a primary dose of morphine.

In the cases that present a well-marked "absorption reaction" there is nausea and infrequently vomiting. Some epigastric pain is complained of but these symptoms rapidly pass. Usually a few teaspoonfuls of water or a few drops of aromatic spirits of ammonia well diluted controls the condition if it appears to persist. The one great danger is that of respiratory depression and paralysis. This condition is secondary to the extension and absorption of stovaine high up the spinal canal. In one case, 55 years of age, herniotomy, this was well marked. Head was elevated and strychnine administered hypodermatically. Condition passed off in about five minutes without the necessity of resorting to artificial respiration. In this case I feel that a definite idiosyncrasy was present.

The after-treatment of stovaine analgesia is practically negative. A hypodermic of morphine as has been previously stated is administered at completion of operation. This lessens the post-operative shock as pain sensibility is regained. In occasional cases, severe headache is encountered. This is best treated by absolute rest, ice-bag and careful elevation of the head. If persistent, fluidextract ergot in drachm doses usually gives relief.

The following table shows the variety of operations in which stovaine has been successfully employed as an analgesic agent at Sing Sing:

Herniotomy, inguinal, single	58
Herniotomy, inguinal, double	2
Herniotomy, inguinal, strangulated	2
Herniotomy, inguinal, and hydrocele	1
Herniotomy, inguinal, and appendectomy	1
Herniotomy, inguinal and undescended testicle	1
Herniotomy, femoral	1
Hemorrhoids, internal and combined	15
Fistula in ano	16
Appendectomy	14
Circumcision	14
Varicocele, radical	13
Hydrocele, radical	9
Hydrocele and varicocele, radical	1
Varicose veins, leg	2
Prostatectomy	2
Urethral fistula	1
Urethrotomy, external	1
Orchidectomy, tubercular	2
Orchidectomy, sarcoma	1
Peritonitis, tubercular	1
Rectal prolapse, excision	1
Inguinal adenitis, excision	2
Redundant prepuce, excision	1
Exploratory incision	1
Compound fracture, both ankles, reduction	1
Exostosis, tibia, excision	1
Necrosis, tibia, curettage	1
Hallux valgus, excision	1
Toe, amputation	2
Total	169

The average age of the prisoners operated upon was from 25 to 30 years. From the foregoing table it will be seen that prison surgery embraces a broad field and the use of an analgesic agent such as stovaine will aid the prison physician decidedly in overcoming the difficulties that beset him in the treatment of surgical cases.

MEDICOLEGAL ASPECTS OF ANÆSTHESIA.*

BY F. HOEFFER McMECHAN, M.D.,

OF CINCINNATI, O.

WHILE the anæsthetist is bound by those rules which govern the professional conduct of all registered or licensed practitioners, still, in many respects, his position is ill defined and subject to modifying circumstances. This is due to the fact that only during the last few decades has the anæsthetist been acquiring some independence, and consequently only a limited number of legal decisions are available for his guidance. These medicolegal aspects of anæsthesia, however, are of sufficient importance to demand conscientious consideration from those who are making anæsthesia a "specialty."

In the ordinary routine of his work the first legal obstacle that confronts the anæsthetist is the question of consent.

Consent.—No person can be legally anæsthetized without consent, unless the anæsthetist opens himself to a charge of assault. In the case of children and the insane, consent must be secured from parents, guardians or those legally authorized to give it.

Commenting on this subject,[1] it is held in England that the power of a parent to withhold consent, even to a necessary operation, is absolute. On the contrary, Judge Leuders, of the Hamilton County Probate Court, Cincinnati, O., recently removed a child from the guardianship of an aunt, who was having her treated by a "faith curist," to the custody of a grandmother, who promised to place the child under proper medical treatment for the contagious disease from which it was suffering. It is probable that a similar jurisdiction would be exercised by the Juvenile Courts, should their medical officers or outside physicians appeal from parental non-consent to anæsthesia or operative procedures, especially in cases of urgency, when the life of the child was involved.

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* Read before the American Association of Anæsthetists, June 18, 1913.

[1] Lancet, May 6, 1911, p. 218.

It is also obvious that many young people, particularly among the working-classes, although legally "not of age," are practically independent of their parents. The Canadian Courts[2] furnish a case turning on this point. The patient having agreed to an operation, to which his parents had not consented, the judge's decision was against their protest, on the intrinsic merits of the individual case, rather than upon any fixed principle or newer interpretation of the law.

Actions have been brought for alleged anæsthetization without consent, especially when the patient and anæsthetist have been alone together, and the anæsthetist has also assumed the rôle of operator. The majority of these cases have failed on the grounds that anæsthetization by force was impossible and that there was collateral evidence of consent; but in each instance anæsthetists have been put to the inconvenience of framing a legal defence.

As early as 1867, in Absolom *v.* Statham, Judge Cockburn of England, summing up an action brought against a medical man for forcibly administering chloroform to the plaintiff against her will, for a dental operation, issued this dictum from the bench, that: No surgeon had the right to anæsthetize an individual or perform any operation against the will of a patient, so long as the person preserved consciousness and will, without opening himself to a charge of assault.

Thus, if a patient, who is about to be operated upon, changes his mind during the induction of narcosis, and objects, the anæsthetist must desist from any further efforts at anæsthetization, unless the anæsthetic has so far taken effect that he may reasonably infer that the conscious exercise of judgment has been lost. This seems rather a far-fetched contingency, but a personal experience proves the contrary.

Illustrative Case.—Some years ago Dr. Hinckley, surgeon to St. Mary's Hospital, Cincinnati, O., was to operate upon a woman for appendicitis. The patient was apparently resigned to the ordeal, until during the induction of anæsthesia with chloroform by the drop-method, when she used a woman's prerogative and abruptly changed her mind. She sat up on the operating-table, and demanded to be returned to her room, unoperated. Persuasion was found to be useless and she was accommodated in her desires, all the medical men interested, washing their hands of the case. It is the unexpected that occasionally happens. To have attempted forcible induction of anæsthesia under the circumstances could easily have led to the preferment of a charge of assault, and in case of an anæsthetic fatality, there would have been additional grounds for a prosecution of manslaughter.

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[2] J. D. Mortimer: Anæsthesia and Analgesia, University of London Press, p. 256.

The anæsthetist may also be placed in a rather embarrassing position should the operating surgeon find it impossible to keep within the limitations of the operation to which consent had been given; and not only modify the intended operation, but perhaps attempt to substitute an entirely different one, of which the patient or relatives may afterward disapprove, or which of itself may inject the important element of fatality into the procedure. Under certain operative circumstances the anæsthetist would find it impossible to withdraw without jeopardizing the patient's life, and he can only protect himself by entering a protest against the procedure, while at the same time he bends his every effort toward a fortuitous outcome. The case of Lawson *v.* Crane & Hall has an indirect bearing on this point.[3]

The lower courts of Vermont had awarded a judgment for damages in favor of the plaintiff. During the trial, however, testimony of the defendant, that he had protested against the contemplated operative procedure, although he had later administered the anæsthetic during its performance, was excluded. On appeal the Supreme Court held that: as the defendant had already advised against any operation at the time and place it was performed, but his advice had been disregarded, and the operation had been performed contrary thereto, and was not subject to his control, he having only administered the anæsthetic in the capacity of an assistant, therefore he was not called upon to again object to or protest against the said operative procedure, and hence no inference of approval could be drawn against the defendant from his silence in that respect. Therefore judgment for the plaintiff is reversed and his petition dismissed with costs.

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[3] Supreme Court, 74 Atl. R. 641, Jour. A.M.A.

The recent passage of Workmen's Compensation Acts by the legislatures of Ohio and California, although the New York Act has been declared unconstitutional, adds a new element of consent to anæsthetization and operation for medicolegal consideration.

In the adjudication of the Workmen's Compensation Act, passed by Parliament in 1906, the English courts have held that an injured employee must submit to any reasonable operative procedure that will lessen his disability. The case of Bourne *v.* The Middle-Sussex Water Board notes an exception to compulsory submission to an operation, if there is danger from the anæsthetic.[4] The following is a brief summary of this important case.

Henry Bourne, laborer, sixty-two, claimed compensation under the Workmen's Compensation Act, before the Haywards Heath County Court, March 18, 1909, for injuries sustained while in the engine room at the Balcombe Water Works, on September 28, 1908, under employment of the Middle-Sussex Water Board. Bourne was called upon to assist in moving a heavy valve, which fell on one of his hands, causing serious injury. He became totally disabled. The employer, on advice of a medical practitioner, suggested that the hand should be operated upon with a view of straightening the fingers; contending that if this was done Bourne would be able to resume his work in the ordinary way.

The plaintiff, however, refused consent to any operation and two medical men gave evidence that an operation was inadvisable as the plaintiff was not a proper subject for an anæsthetic. The respondents contended that this objection was not a reasonable one and asked for the decision of the judge: whether the plaintiff's present condition was not the result of his unreasonable objection to undergo an operation. His honor, Judge Scully, held that: the plaintiff's objection to an operation on account of the coincident danger of the anæsthetic was not unreasonable and made an award of compensatory weekly indemnity.

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[4] Lancet, March 27, 1909, p. 939.

Similar cases are bound to arise in the adjudication of Workmen's Compensation Laws in this country, and as several fatalities under anæsthesia have already occurred in England, to persons submitting to operation under the requirements of the law, any individual case in which there is grave danger from the anæsthetic should be carefully considered, before consent to an operative procedure is legally demanded.

The question of consent to an examination under an anæsthetic in connection with a military pension, was brought before Parliament, in 1907, by Mr. Wedgewood Bain. It appears that a soldier named Craig had been required by the War Office to undergo an examination under an anæsthetic before the continuation of his pension would be granted. Mr. Haldane, answering for the War Office, stated that an anæsthetic would not be administered unless it was considered safe by the medical authorities, and the latter would be glad to receive any evidence that Craig was unfit to submit to general anæsthesia; but the ultimate decision as to whether he was or was not fit must rest with the medical examiners of the War Office. In the event of death under the anæsthetic the man's dependents would have no claim to compensation against the government.[5]

Mr. Haldane's last remarks have since been abrogated by several decisions under the Workmen's Compensation Law, which will be quoted at length later on.

It must also be remembered that in the employment of untried anæsthetic agents or in initiating newer methods of administration, a grave responsibility rests with the anæsthetist, unless the patient is fully advised of the experimental character and possible untoward results of the procedure, and his consent to the trial has been previously obtained.

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[5] British Medical Jour., vol. i, 1907, p. 1327.

Two very important questions now arise: Who is legally qualified to administer anæsthetics, and what legal regulations regarding the administration of anæsthetics have been promulgated.

The limiting of the administration of anæsthetics to legally qualified practitioners has been presumed in the context of the various state medical practice and license laws, without having been definitely expressed. The nurse-anæsthetist abuse, perpetuated and endorsed by certain surgical clinics, has insiduously crept into the ranks of the profession. There is every promise that this abuse will be speedily abolished by amendments to the medical practice acts or by action of the state societies.

Undoubtedly the opinion of Attorney-General Hogan of Ohio will prevail. He holds that: the use of anæsthetics is a "medical act," and consequently the administration of anæsthetics must be limited to legally qualified practitioners of medicine or dentistry.

There is no Nurse's Bill extant which expressly conveys the legal qualification to administer anæsthetics, and the new Nurse's Bill, now before the Ohio legislature, specifically prohibits the practice. Undoubtedly the agitation of the subject in New York will eventuate in a similar prohibition.

In August, 1909, the Chief of the Board of Health, Vienna, issued to all hospitals and out-patient departments of the Austro-Hungarian Empire, the following regulations regarding the administration of anæsthetics:

1. To have each and every patient especially examined before being put under the influence of any anæsthetic.

2. To limit the use of inhalation anæsthesia to such cases in which this method of narcosis was absolutely necessary. In all other instances local or regional analgesia was to be considered the method of choice.

3. Under no conditions would the same physician be allowed to anæsthetize and operate upon a patient.

4. Legally only qualified medical men would be privileged to administer anæsthetics.

5. Students would be permitted to administer anæsthetics only after instruction and then only under proper supervision.

6. Finally the chemical purity and non-deterioration of the anæsthetic agents would have to be determined before use.[6]

Certainly a set of regulations worthy of the highest commendation and the most widespread promulgation on the part of the Health Departments of our various states and larger cities, particularly in those medical institutions within their immediate control.

At its Dublin meeting, November 10, 1910, the Royal Academy of Medicine discussed proposed legislation regarding the administration of anæsthetics, and the resolutions passed are embodied in a Bill, which the Society of Anæsthetists, London, under the leadership of Sir Frederic Hewitt, is attempting to pass through parliament.

The general provisions of this bill are as follows:

1. That it is advisable in the public interest that the administration of general anæsthetics to render persons unconscious during any medical, surgical, obstetrical or dental operation or procedure, should be restricted by law to registered medical practitioners, with this exception, that the specification of the anæsthetic drugs which may be employed by registered dental practitioners during dental operations or procedures, should be made in a schedule, power being reserved to the Privy Council on the recommendation of the British Pharmacopœia to add to or vary the specified list from time to time as occasion may require.

2. That provision should be made for the instruction of medical and dental students in the administration of anæsthetics.

3. That the administration of local analgesics for producing insensibility to pain during any surgical or dental operation or procedure, by the introduction beneath the skin or mucous membrane of any fluid or other substance by a hypodermic needle or in any other way, should be restricted by law to

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[6] British Medical Jour., August 21, 1909, p. 496.

registered medical practitioners, registered dentists, or to persons acting under their immediate supervision, such as students and internes.[7]

So much for the regulation of the administration of anæsthetics under the civil law. The state of New York has gone further, and has incorporated a section in its penal code. This section reads as follows:

> Section 1752: A person, other than a duly licensed physician or surgeon engaged in the lawful practice of his profession, who has in his possession any narcotic or anæsthetic substance, compound or preparation, capable of producing stupor or unconsciousness, with intent to administer the same or cause the same to be administered to another, without the latter's consent, unless by direction of a duly licensed physician, is guilty of a felony, punishable by imprisonment in the state prison for not more than ten years.

The occurrences of fatalities or untoward results under anæsthesia bring the anæsthetist before the bar of Coronial inquiry, and leave him open to suits for malpractice or prosecutions for manslaughter. Scotland is perhaps the only country in which no coroner's inquests are held upon "deaths under anæsthesia."

With regard to deaths under anæsthetics the Medicolegal Committee of the British Medical Association, at the annual session in 1910, reported as follows in connection with the law of coroners:

> Most coroners hold, it appears, that when a person dies under an anæsthetic given for the purpose of a surgical operation, the death is an unnatural death, within the meaning of Sec. 1 of the Coroner's Act of 1887, and that the coroner is bound to hold an inquest.
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> Others, however, consider that they have discretion, if after preliminary inquiry they are satisfied that the administration of the anæsthetic was necessary, that it was properly given by a competent person, and that death was due to inevitable accident.[8]
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> In the public interest we think that the coroner ought to have this discretion. Every case of death under anæsthesia, whether it occurs in a

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[7] British Medical Journal, vol. ii, 1910, p. 1652.

[8] British Medical Jour., vol. i, 1910, p. 826.

> public institution or a private house, should be reported to the coroner. If the coroner on due inquiry is satisfied that all due care and skill have been used, we think it is undesirable that there should be an inquest.

R. Henslowe Wellington, an English coroner of broad experience, in writing upon coroner's law, deplores the undesirable tendency to cause alarm in the minds of the public by sensational reports of inquests on deaths under anæsthesia.[9]

On the contrary, Dr. Waldo, Coroner for the City of London and Southwark, advocates inquests in all anæsthetic fatalities. Also he holds that the legal responsibility for the casualty rests with the person by whom the operation is controlled, that is, by the surgeon. He maintains that if the operator can be justly accused of selecting an assistant, who had not had sufficient experience to enable him to give the anæsthetic properly, and was himself so engaged in the operation as to be unable to personally supervise the administration, then in case of accident the surgeon can be held liable under the law, and in case of a charge of malpractice or a verdict of culpable neglect by a jury, it might become the duty of a coroner to commit the operator, not the anæsthetist, for manslaughter; except in cases where the anæsthetist happened to be in an unfit condition at the time or showed gross carelessness.[10]

Commenting on this matter the Law Journal says:

> Where patients submit to or are subjected to operations which require or are better done under anæsthetics, they and those whose subscriptions maintain the hospital are entitled to some guarantee that the utmost skill and care shall be used, and it is well that an inquiry has been instituted with reference to the very frequent deaths in hospitals under anæsthetics, for it is not desirable to have these matters decided by a prosecution of doctors for malpractice or manslaughter.

In a discussion at the meeting of the Medicolegal Society, London, April 27, 1909, regarding the relative responsibility of surgeon and anæsthetist, Mr. Cowburn stated that he could find no recorded case in English law in which either criminal or successful civil action had been brought against a medical man on account of death resulting from or occurring whilst under the influence of a general anæsthetic. Each case had been tried on the facts and the jury's verdict had been given in the light of the attending circumstances.

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[9] Lancet, October 8, 1910.

[10] British Medical Jour., January 4, 1908.

Mr. Cowburn further submitted that if negligence could be proven in respect of the administration, the medical practitioner actually administering the anæsthetic, was liable, not the surgeon, who was engaged in the operation. If the surgeon, however, took upon himself to decide the particular kind of anæsthetic to be employed, or the technic and apparatus to be used, or the amount of the anæsthetic to be administered, he would be held jointly responsible with the anæsthetist for any unfortunate result to the patient.[11]

But when a nurse or a student was engaged in the administration of an anæsthetic under the direct supervision of a medical man, there then existed the relationship of master and servant, and in the event of any untoward accident the qualified practitioner could be held responsible.

In those cases arising from deaths under anæsthesia, which have come to trial in the English courts on pleas for damages or on prosecutions for manslaughter, the following defence has always proven successful: (1) that the administrator was a qualified medical man, that (2) both the operation and anæsthetic were necessary, that (3) the administration was conducted with the experience and knowledge ordinarily demanded, and that (4) death was unavoidable and not due to carelessness or want of skill.

It would appear for the future that the apportionment of responsibility between the surgeon and anæsthetist, in the event of a casualty, would more or less depend upon whether the anæsthetist was acting merely as an assistant or had been employed as a "specialist" It is gradually becoming the custom for coroners to summon the anæsthetist in cases of inquests for deaths under anæsthesia, and not to summon the surgeon, unless death has been due to some operative accident rather than to the anæsthetic. In these days of specialism anæsthetization can no longer be considered merely a part of the surgical procedure.

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[11] Lancet, May 8, 1909.

Mortimer suggests that in becoming a "specialist," the anæsthetist opens himself to actions for damages on account of injuries sustained during anæsthetization; for example, the breaking off of a tooth from forcibly opening the mouth; injuries sustained during struggling; bruising of the tongue; accidents or failures such as loss of an eye from a movement of the head or inability of the surgeon to complete an operation, or such after-effects as brachial paralysis, burns from hot water bottles, etc. While there is considerable speculation in the foregoing, still the anæsthetist through carelessness may readily bring a damage suit down upon the head of the operating surgeon or the trustees of his hospital.

There is a case quoted in the American Encl. Digest in which, in a Western hospital, after a patient had been successfully operated, he was carelessly dumped down an elevator shaft while being returned to bed. In this case, the patient still being under the influence of the anæsthetic, the operating surgeon was mulcted of heavy damages.

There is a suit pending in the Hamilton Co. Courts, Cincinnati, against the German Deaconess Hospital, for burns sustained by hot-water bottles, while the patient was still under the influence of the anæsthetic, post-operatively. This suit revives interest in that of Ward *v.* St. Vincent's Hospital, in which the Supreme Court of New York, by the opinion of Judge Gildersleeve, reversing the lower courts, on retrial, gave a verdict of $10,000 damages to the plaintiff for breach of contract due to injuries resulting from burns by a hot-water bottle, while under the influence of ether after an operation. In the lower courts the judge had directed a verdict for the defendant on the ground that the hospital was a charitable institution and therefore not liable for the negligence of employees. On appeal it was proven that the plaintiff was a pay patient, and hence the verdict for damages on the grounds of alleged breach of contract.

In the case of Hillyer *v.* Governors of St. Bartholomew's Hospital, for alleged burns and brachial paralysis sustained during an examination under an anæsthetic, Justice Graham took the case from the jury on the grounds that the plaintiff had not proven negligence, and gave a verdict in favor of the defendants. On appeal, Lord Justice Farwell, said with regard to the question of liability that: surgeons and anæsthetists are not under the direction of hospital governors or bound to obey their orders, and therefore cannot be regarded as being their servants, for whose acts they would be liable. The governors were only subject to use care and skill in selecting proper persons as members of the hospital staff. With regard to nurses, although primarily the servants of the governors, they took their orders from and were under control of the surgeons during an operation, and thus in respect of duties so performed, ceased to be the servants of the governors.

In the Edinburg Sheriff Court, in 1909, damages were awarded to a plaintiff, who claimed them, in respect of injuries sustained by her through being burned by a hot-water bottle, when under an anæsthetic for an operation. The claim was made against the Edinburg Hospital and Dispensary for Women and Children, and the Sheriff Substitute, who found for the plaintiff, adopted a contrary view of the law from that enunciated by the Court of Appeal in the case of Hillyer *v.* The Governors of St. Bartholomew's Hospital. The judgments of the Court of Appeal of England are not binding on the inferior courts of Scotland and *vice versa,* although they are often cited and generally receive the consideration due them.

From the foregoing it is apparent that the conscientious anæsthetist is in duty bound to exercise every possible precautionary measure to prevent anæsthetic or postanæsthetic accidents, unless he wishes to involve the operating surgeon or his hospital in an action for malpractice or damages.

There are several decisions under the English Workmen's Compensation Act, with regard to anæsthesia, which are of importance. The case of Bourne *v.* The Middle-Sussex Water Board has already been quoted, and under its ruling, workingmen not fit subjects for anæsthesia cannot be forced to undergo operations for the mitigation of their disability. In Shirt *v.* Calico Printers' Association Lim't'd, the Master of the Rolls, on appeal, allowed the claim of a widow for compensation under the Workmen's Compensation Act, on account of the death of her husband under chloroform, while submitting to a second operation of skin-grafting, to minimize his disability consequent upon an accident. This ruling has been followed in several cases, but in Charles *v.* Walker Lim't'd, the widow's claim in respect to the death of her husband, under renewal of anæsthesia for a purpose other than the surgical intervention necessitated by his accidental injury, was disallowed.

The facts in this case were as follows: The widow of the deceased workman claimed compensation in respect of his death, which took place while he was recovering from an anæsthetic administered to him for the amputation of a finger, injured by an accident; the anæsthesia being renewed in order that a tooth, from which he had complained, might be removed. The county-court held that: It was at least as probable that death had been due to spasm caused by an attempt to swallow blood oozing into the mouth, as that it was due to the anæsthetic administered for the first operation, and decided that consequently the widow had not made out her case. The Court of Appeal held that: the county court had rightly directed himself, and that the claimant had failed to discharge the onus which lay upon her to prove the facts upon which her claim depended.

This case emphasizes the absolute necessity of limiting anæsthesia to the operative procedure demanded under the Workmen's Compensation Law, in order that dependents may recover compensation in the event of an anæsthetic fatality.

In order to fully understand the not infrequent prosecution of hallucinatory and delusional false charges of *rape* under the influence of anæsthetic drugs, it becomes necessary to emphasize the fact that erotic sensations, such as women experience during sexual intercourse, occur during the induction period of narcosis. In two instances the author has observed this phenomenon, personally; and once, during the induction of anæsthesia, the actions of a young woman were of such a character as to embarrass all those who were present in the operating-room, although there was fortunately no realization post-operatively of the sexual excitation.

The mystery which has been allowed to surround the subject of sexuality is responsible for the unscientific delicacy with which the inquiry into the subjective sensual sensations of women has been pursued. But if these erotic hallucinations or fixed delusions take the practical form of a charge of rape, preliminary confinement to jail and a trial by jury, they pass from the domain of sentiment and enter the realm of legal medicine for investigation and adjudication.

Comparatively few members of the medical or legal profession sufficiently realize that women, during the induction period of narcosis, are subject to hallucinatory and delusional sensations, identical with the eroticism and orgasm associated with the sexual act. These erotic sensations arise quite subjectively, and without any extrinsic stimulus, aside from the coincidental administration of the anæsthetic. The delusion of St. Catharine that the devil visited her and violated her person, when she was asleep and could offer no resistance, is no unique experience. Everyone familiar with asylum supervision knows that a certain percentage of women patients have this delusion, among others, that the medical superintendent comes nightly to their bed and enjoys their person during sleep. There is absolutely no foundation in fact for such delusions except the subjective, erotic sensations of these women.

How strongly such erotic delusions may become fixed in women's minds is evidenced by unfounded charges of rape by women, who have persisted in their belief, when relations or others were present during narcosis, under circumstances that rendered criminal assault physically impossible. Such being the case, it is advisable always to have another person, preferably a woman friend or attendant, present without intermission during the whole time that a female patient is under the influence of an anæsthetic, and that such other precautions be taken as will preclude the possibility of an unfounded charge being raised.

While designing women have occasionally brought false charges of rape for purposes of blackmail; or when already pregnant, in an effort to fix the parentage of the prospective infant upon some innocent medical man, still in most instances when hallucinatory or delusional false charges of rape have been pressed, modest, virtuous and refined gentlewomen have been the accusers.

Dudley Buxton in commenting on this subject says that: Chloroform, ether, nitrous oxide and even cocaine possess the property of exciting sexual emotions and in many cases produce erotic hallucinations. In certain persons sexual orgasm occurs during the induction of anæsthesia. Women, especially when suffering from ovarian or uterine irritation, are prone to such hallucination, especially during the menstrual period.

Turnbull in his Artificial Anæsthesia, quotes the case of Child *v.* Dash, which was tried at the Northampton Assizes, Nov. 9, 1877, by Mr. Justice Hawkins. After lying in jail from the 14th of September to the date of trial, this surgeon's assistant was finally acquitted on a delusional charge of rape under anæsthesia, the accused being entirely cleared of any imputation in respect to the charge preferred against him.

Within a year of Morton's discovery of the anæsthetic effects of ether, the *Gazette Medicale* (Paris), July 31, 1847, reports the first recorded case of criminal assault under anæsthesia.

A patient went to a dentist to have a tooth extracted, and to avoid pain, he recommended her to inhale ether. The young woman was observed to leave the dentist's house in a very disordered state about three hours after entering it. This attracted the attention of her employer, who could not account for her long absence. The injured party, notwithstanding the effects of the ether, retained some recollection of what had transpired, and from some intimations she let fall suspicion was immediately aroused. She was examined by a physician who reported that her person had been violated. The dentist was arrested and prosecuted.

Taylor in his Medical Jurisprudence, quotes the law regarding criminal assault and narcosis as follows:

When narcotics or intoxicating liquids have been administered to a woman either by the prisoner or through his collusion, it matters not, in cases of rape, whether the narcotics have been given merely for the purpose of exciting the female, or with the deliberate intention of having intercourse with her while she was intoxicated or unconscious,—the prisoner is equally guilty.

In the case of Reg. *v.* Snarey, Winchester Lent Assizes, 1859, for criminal assault under the influence of an anæsthetic, there was a clear attempt at fraud. The prosecutrix asserted that she was instantly rendered insensible by the prisoner forcibly applying a handkerchief, saturated with an anæsthetic, to her face, and she accused him of having committed rape upon her. The charge was disproved by a distinct alibi, as well as by the improbability of all the circumstances. In a parallel case, that of White *v.* Howarth, the prosecutrix made a similar assertion, and added that she was aware of what was going on, but was unable to resist.

In attempts at criminal violence under an anæsthetic administered without the victim's consent, fear, excitement and struggling would all be against the possibility of arriving at a loss of voluntary power without deep narcosis. It is very doubtful whether a person, be he an expert or not, could anæsthetize a waking adult against his will, unless there existed a very unusual disproportion between the strength of the two individuals.

Also there is something suspicious about the attempted use of anæsthetics in burglary. Persons left to guard banks and other places containing valuables have on numerous occasions affirmed that they were rendered unconscious while robbery was committed, but in almost all these instances, the persons uttering the charges have been either the actual depredators or in collusion with them. This subject opens up the question as to whether people can be anæsthetized during sleep. There is not time at our disposal to discuss this problem, but the reminder of Taylor is apropos. *"Non omnes dormiunt quae clausos habent oculos."* Not all are asleep because they have their eyes shut.

Occasionally in the routine of hospital service it becomes necessary to anæsthetize patients who are the victims of attempts at murder or manslaughter. Needless to say some of these patients are almost *in extremis*. However, if the anæsthetist uses skill and care he has nothing to fear, judicially, in case of a fatality. The Amer. & Eng. Encyl. of Law, quotes the following law on this subject:

> Although a wounded man may die of strangulation produced by an attempt to administer restoratives to him, or from a surgical operation honestly believed to be necessary or from chloroform administered to facilitate such operation, or from an accident occurring during its performance,—yet as death from any such causes is directly referable to the original injury, this is to be regarded as the judicial cause of death.

In such cases, however, the anæsthetist for his own protection should keep a careful record of his procedure in administering the anæsthetic, as he may be called upon to testify in court.

In 1907, the Council of the British Medical Association, gave notice that any registered medical practitioner, who by his presence, countenance, advice, assistance or co-operation, knowingly enables as unregistered person to attend or treat any patient, is liable to be judged guilty of infamous conduct in a professional respect, and to have his name erased from the Medical Register. Since that time a practitioner has been stricken off the Register for administering nitrous oxide to enable a bone-setter to make an examination.

A personal experience in which the author is morally certain that a gynæcologist of standing, performed a criminal abortion under the guise of a curettage for endometritis, emphasizes the fact that an anæsthetist may unconsciously be misled into administering an anæsthetic for an illegal operation. In the event of the anæsthetist becoming familiar with the illegal nature of the proposed operation previous to the induction of narcosis, he would certainly be incriminating himself by continuing in the case. Likewise, should there be a suspicion of fraud with regard to the proposed operation, or any indication that it was being performed to obtain money under false pretences, the anæsthetist would do well to retire from the case.

In the Brompton County Court, March 11, 1907, a point of some interest was raised in respect of fees due for the administration of an anæsthetic. The plaintiff, an anæsthetist, claimed 10 guineas from the surgeon defendant, for 10 administrations of an anæsthetic to the latter's patients, contending that it was the custom for the medical man in charge of a case to hold himself responsible for any fees due to an anæsthetist. This was necessary because knowledge of the patient in so far as the anæsthetist was concerned and the relationship between them began and ended with the performance of the operation. Evidence for and against this view having been given by various persons the judge ruled that:

" The custom existed and gave judgment for the plaintiff for 6 pounds; this being an average between the fees variously stated as commonly paid anæsthetists."

The further question of a contract assistant's right to anæsthetic fees for services rendered another practitioner has been recently raised in England and has been disposed of as follows:

" Under the usual contract between a medical principal and his indoor assistant, the latter is required to give the whole of his time to the principal, and any professional remuneration he is paid belongs, legally, to the principal. The assistant's contract does not oblige him to work for another practitioner, but if he does, he may not receive for himself a fee without the consent of his principal, and it is his duty to proffer him the fee."

In passing it is only possible to mention the value of anæsthesia, medicolegally speaking, in unmasking those who are malingering. M. Baudens, surgeon in the French Army, was the first medical authority to utilize ether anæsthesia as a means of exposing malingering. As early as 1847 he published two personal and illustrative cases of the practical application of ether to medical jurisprudence to distinguish feigned from real disease. Since that time the method has become a routine medicolegal procedure.

Before closing I wish to revive interest in a carbon tetrachloride death, which occurred in the shampoo parlors of the Harrodd's Department store of London, and which resulted in a trial for manslaughter. This sensational case was discussed in detail in the medical journals of 1909, and the *Jour. of the A.M.A.* in its Paris Letter, May 31 of this year, announces that Dr. Levassort has brought the subject of dry shampoo to the attention of the prefect of police and the Council of Public Hygiene and Health of the Department of the Seine, because of the danger of death from the fumes of carbon tetrachloride. On account of the prevalent use of certain dry-cleaners in the United States, the trade names of which betray the presence of this poisonous volatile anæsthetic, it would seem that this association might take some action in the matter of investigating the problem and issuing a warning against their use.

In closing, the remarks of Mortimer on the anæsthetist's conduct in court are especially apropos; he says that:

" In giving evidence that the anæsthetist should follow the general advice given to medical witnesses in books on Forensic Medicine. He should study the subject of inquiry carefully beforehand, considering what questions are likely to be put to him, how his evidence may be regarded by any one outside the medical profession, and any weak points which may be seized upon to his disadvantage. If coming before the coroner, or a magistrate, or a county court judge, he should remember that the case may be carried further, and copies of his evidence given in the first instance, produced in the second, and that there should be no discrepancies from carelessness or lapse of memory between the evidence given on the two occasions.

" He should give his answers deliberately and distinctly, pausing at the end of sentences so that his testimony may be taken down. Any approach to levity, irritation or discourtesy should be avoided under all circumstances. Answers should be given in language, free as far as possible from technical terms and also from vague and exaggerated expressions. Answers should be limited to the questions asked, and the anæsthetist should confine himself to facts, unless required as an expert to comment on them. He should object to involved, suggestive or hypothetical questions, and should appeal to the judge for permission to explain when a categorical answer would be misleading. Arguments and theoretical discussions are also to be avoided. No decided opinion should be expressed on insufficient data, and therefore one as to the cause of death should not be given in the absence of an autopsy, preferably conducted with the assistance of a skilled pathologist."

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